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In this issue:

What is the Matter With Contracting?

By W. J. Barney

President, Barney-Ahlers Construction Corporation, New York

An inquiry and some possible answers by a contractor for the consideration of contractors, engineers, architects, bankers and owners

Also:

Engineering in the Small City: The Editor Visits Eugene, Oregon

Report of Excursion Convention of New England Water-Works Association

Santa Fe Engineering Quarters in New Office Building in Topeka

Driving the Wanaque Tunnel for North Jersey Water Supply

Review of Recent Engineering Literature

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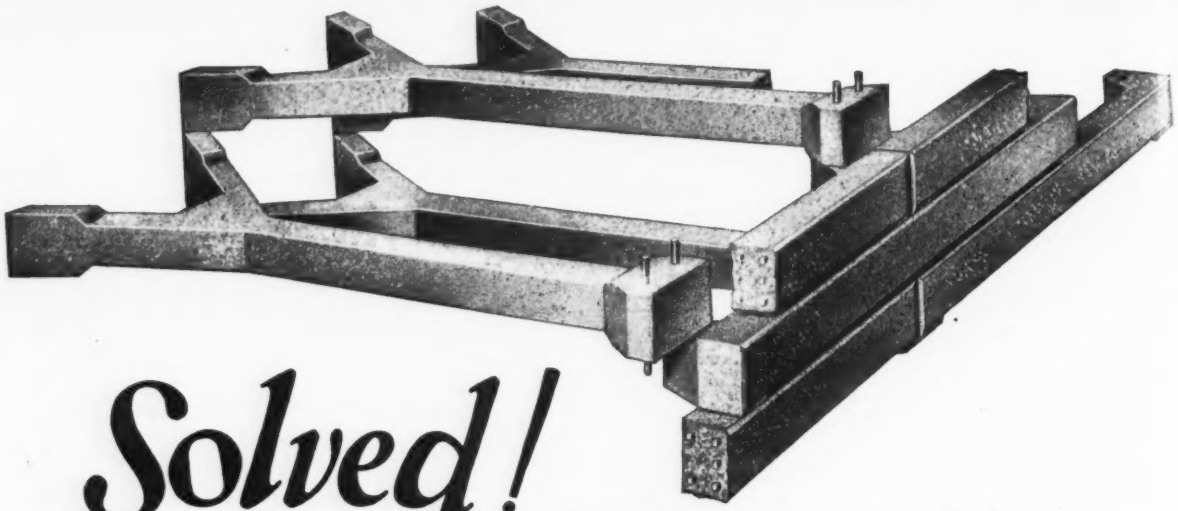

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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Learning About Cement

TRUE scientific spirit is behind the cement research now being carried on by the Bureau of Standards with the co-operation of the Portland Cement Association. That means that the periodical results will be of little or no importance either to the cement producer or the cement user, but that the final results may be of commanding importance to both. The amateur chemist and occasionally the engineer will talk glibly about portland cement, its make up and its nature. The real student of cement knows how little he or his confreres really know about it. A day's visit to the research laboratories at Washington where the scientists are ploddingly trying to rend the veil behind this common but mysterious compound will convince anyone that portland cement is far from being a simple substance whose history is known and whose behavior is manifest. In a year or two results will come out of the research which should, on being properly interpreted, do much to help the manufacturers to make better cement and the engineers to make better concrete.

Artificial and Natural Rock Dams

WHEN the great landslide on the Gros Ventre was first reported in June there were a number of engineers, particularly in the Far West, who were greatly interested in its details, thinking that possibly there could be learned from it something that might be useful in any future consideration of blast-made rock-fill dams. It will be remembered that several proposals have been made for dams on the Colorado which were to be formed by blowing down large volumes of rock from the canyon sides. The report on the Gros Ventre slide by State Engineer Emerson in this issue indicates that the geological readjustment which took place was one fairly common to this type of country but that it was of uncommonly large extent. Aside from that, however, the lessons for the artificial dam analogue are not particularly valuable except to show that for this type of rock structure, at least, the amount of washable material was so great as to permit the early passage of the entire river flow through the dam. The temporary stoppage built up a reservoir but that presumably in time will run away when the low-water period of the stream arrives. A landslide does not exactly parallel a prepared rock fall such as was proposed for the Colorado, but there is enough resemblance to arouse some question of the watertightness of the latter.

Conventions En Route

NOVELTY cannot be claimed for combining a convention with a long excursion trip, as did the New England Water Works Association on the St. Lawrence and Saguenay Rivers last week, but seven sessions aboard a single steamer during a period of four nights and three days, with ample time for a number of side trips ashore is not a common occurrence, especially in the civil engineering field. The meetings went off at least as well atop the *S. S. Richelieu* as in the usual hotel ball room but the associate members were quite cut out of their usual exhibit of appliances, as were the active members from its benefit. How fully the associate, and the active, members were compensated for this by greater freedom of time and conscience to play golf on the many occasions afforded for this on shore we leave for them to say. The expectation that because the sessions were aboard ship, those making the trip would, through lack of counter attractions, attend all the meetings was not wholly justified, for the attendance at the sessions was small. Smallness of attendance and lack of exhibits will doubtless be counted as large factors against repetition of the plan of a long excursion with meetings en route, but does not condemn the plan for an occasional variation of the ordinary convention, held ashore in a single city. Those who made the trip appeared to be satisfied. Just what the reaction of the plan was on those who ruled it out from the start or the 70 who cancelled reservations the week before the convention is a question that the present and future officers of the association might well consider.

Four-Rod Roads Going

FOUR rods have since the earliest days been the width of land which it was deemed suitable to take for a public road. In the curious origin of English units of measure there is perhaps an explanation of the choice of this odd width of 66 ft. for a highway, but today it has no logic apart from the claims of precedent and tradition. Indeed there is very good reason why it should go. It is too cramped for trunk line roads as they are now conceived where traffic is heavy. For heavy traffic 18-ft. pavements and 6-ft. shoulders are held to be narrow and road engineers widely are changing to 20-ft. pavements and 8-ft. shoulders—to a 36-ft. roadway. There is scant room for such a road in a 4-rod right of way and it requires no clairvoyance to perceive that the present 20 ft. is merely a stage in the widening of road surfacing. So while the land can yet be had at reasonable cost highway departments are urging that the 4-rod right of way be increased to 100 ft. Perhaps the state which has gone farthest in this task is Michigan. Its trunk-line standard is now a 20-ft. surfacing, 8-ft. shoulders and a 100-ft. right of way and it is rapidly acquiring the additional width of land on its main trunk highways. Indeed it is none too soon for all road departments to take up the work of pushing apart the right of way fences along their main traffic lines.

The Matter With Contracting

CONTRACTING is developing an acute perception of its ills. The fortunate feature of this growing sensitiveness is that it is alert to the fact that the blame for conditions rests heavily on contractors themselves, and that the major task of reform is theirs to undertake. This includes reform in engineering and architectural practices, in the policies of owner and financier and in the customs of materials and equipment producers, but initiation and execution of improvement are the contractors' task. They may logically expect from other building interests only complaisance with their reform activities. It is the keen understanding of these facts which gives the article in this issue by W. J. Barney, contractor, its high value.

It is a good thing to have the things which Mr. Barney says about contracting said by a contractor. Were the charges of ignorance and incompetence with which the article bristles made by the engineer or the banker they would be attributed to almost any motive other than conviction by fact. Indeed we question whether pricked vanity will not blind many contractors to this testimony from their own ranks. As the article implies, however, the time has come for contracting to consider its situation with unblurred vision. Neither the average profits of contracting nor the tenure of life in the business, as pointed out in the article, is a cause for pride. Indeed other business men who contemplate the figures must wonder whether most to admire the contractor's courage or to pity his intelligence.

It is moreover in other respects than poor estimating and low bidding and weak judgment that the discussion by Mr. Barney most stimulates engineering thought. The comment on the lack of distinction between classes of contractors concerns the engineer acutely. The condition is the cause of his greatest worry in supervising construction. He knows as well as do contractors that there are shades of quality in contracting. Architects know it. When they think about it, even owners are aware that there is good contracting and poor contracting. Yet commonly in letting contracts no indication exists that all contracting is not equal in quality and all contractors not of the same class.

More than that, in the execution of contracts there is no comparative measure. The work called for by the contract is either completed or it is not. On the one side of the line is work so poor that it is not acceptable, while acceptable work may vary from just good enough to get by to superlative. Quality performance has a vague influence on owners and engineers and architects but the influence recedes perceptibly before the impressiveness of the low bid.

There is hardly any other activity where relative quality is not rewarded. This is the strange anomaly of the construction industry. Also it is the one for which it is most difficult to perceive any correction. An improvement in surety bonding practices will help, and so will other movements which contractors have under way, but convincing the owner that there are variations in quality of contracting and that higher quality warrants higher price is the fundamental solution.

At this point owner and engineer are bound to urge that the remedy is already in the contractor's hands—that all he has to do is to refuse work at prices less than good work demands. The fallacy of this argument is that ultimately the contractor must take contracts. In short here is a situation in which the owner and the engineer must lend a strong hand to the contractor, and the article by Mr. Barney does good service in emphasizing this. Irresponsible contracting is not wholly the creation of contractors; banker, owner and engineer have all helped to father the defective. None of them, and least of any the engineer and the architect, may stand aside with free conscience and let the contractor wage the battle alone for recognition of craftmanship in contracting.

The need of organization is stressed in Mr. Barney's article. This is well enough but blame rests elsewhere. Contracting through its national and local associations is undertaking just what it is asked in the article—"setting up real codes of ethics, and platforms for estimating work, executing contracts and keeping costs." The faults against which the article inveighs are not lack of contractors' associations or of high association ideals or of active association endeavor, want of codes or rules or forms of practice; they are failure by the individual contractor to abide by the codes and to employ the rules.

Find some way to keep the shyster contractor out of the contracting business and join to that the education of the owner, and his agents, up to an appreciation of quality construction, and the problem is solved. But to state a problem is only the first step toward solving it.

Improvement Assessments

THE studies of the engineering work of small cities now running in our columns disclose a considerable variety of practice in levying assessment benefits to meet the cost of public improvements. Nearly all the methods thus far described base the assessment on lot frontages, generally with deductions for corner lots and with a considerable range of practice as to making a part of the cost a charge on the whole city or at least on an improvement district. In most cases the plans reported have been arbitrary and so far fixed in advance as to preclude any real judgment as to relative degrees of benefit. That is, the plans generally assume that all property to be assessed at all is equally benefited, and that the measure of benefit is the frontage owned. This has the advantage of simplicity and of long approval by the courts, but it ignores the fundamental principle of assessments for benefits, which is that the property benefited shall share in the cost according to the degree of benefit each piece of property receives, which in turn requires quasi-judicial action on each improvement. Refusal of the courts to go back of the judgment of the legally constituted assessors of benefit, so long as due process of law is observed and fraud and gross discrimination cannot be proved (the latter being exceedingly difficult to establish) does not in itself make the plan commonly followed in accordance with actual and relative benefits, considered from the viewpoints of engineering and public economics.

It is true that a well established, widely used custom, generally accepted by the public without protest, has much to justify it, but even that does not absolve engineers and publicists from trying to work out and secure the adoption of a more scientific plan than those com-

monly in use. An attempt in this direction, made by the city engineer of Baker City, Ore., is set forth elsewhere in this issue. The ingenious and time-saving diagram worked out by the author of the article to facilitate computation is the feature of the article, rather than the benefit assessment plan itself, except that the latter gets as far away from the common frontage plan as to take into account lot depths. This is not far enough, we believe most of those who have gone far into this subject will think. The assumption is that the benefit of street grading, paving, curbs and sidewalks varies, front foot compared with front foot, solely with the depth of lots. If this theory be accepted, the plan of computation seems to be logical and equitable, but after all it is simply basing relative benefits on property value and setting up a method of computing those values. If that be true, why not take the assessed valuations of the property as the basis of computing the street assessments? If it be urged that assessments for general taxation are not scientifically made in a given city, why not reform them as needed, to make them scientific and equitable? But does the benefit conferred by a street pavement or any other public improvement depend upon the value of the fronting property?

Correct Information to Bidders

A FORCEFUL homily was given to engineers a year ago by Judge Bodine of the Federal District Court at Trenton on the subject of supplying correct information to contractors who undertake their work. The learned judge, in a decision reported in our issue of July 3, 1924, p. 21, made it clear that definite rights and responsibilities are created by the statements of information on which a contract is based, and that the usual disclaimer clauses of engineering specifications, to the effect that "the information given is not warranted as being even approximately correct" and so forth, are powerless to deprive the contractor of his legal rights or to relieve the engineer of his responsibilities. Whatever doubts may have remained after that pronouncement are set at rest by the appeals-court decision in the same case (one of the notorious Passaic Valley sewer cases), briefly reported on p. 476.

Judge Woolley, in upholding the prior decision, states explicitly that the disclaimer clause is ineffective. It does *not* shift the burden of risk upon the contractor, though this is precisely what it aims to do. The underlying principle is that a contract clause which seeks to destroy an essential right created by the contract is without force. A construction contract is obviously and necessarily based on certain representations of fact made to the bidder by the owner or his representative, and the contractor, therefore, by virtue of the very fact that the contract was entered into by both parties as a mutual obligation, has the unquestioned right to rely on these representations.

Erroneous information may take several forms of rather different legal aspect, but it is fatal in each form. The different forms were summarized in the lower court decision. For present purposes it is enough to say that faulty information may recoil on the engineer's (and owner's) head whether its faulty character was innocent or intentional. In the former case, where the information furnished proves to be grossly wrong though neither party knew in advance that it was wrong, the contract may be voidable on the ground of material mistake, since the required work is different from that intended by the contract in which the parties joined. In the second case, where the engineer knew that the information was wrong, the case is one of misrepresentation, and the contractor may void the contract because he has been deceived by the engineer. As was said by the Appellate Division of the Supreme Court of New York in a Barge Canal case between the United Engineering & Contracting Co. and the state (*Engineering News-Record*, July 17, 1924, p. 107), "A party to a contract cannot . . . protect himself from the legal effect of misrepresentation by inserting in the contract a clause to the effect that he is not to be held liable. . . . The effect of misrepresentation and fraud cannot be thus easily avoided."

There may still be some legal doubts concerning the effect of innocent misrepresentation. The New York Court of Claims, in another Barge Canal case (*Engineering News-Record*, July 3, 1924, p. 24) said that the disclaimer clause "could avail the state only in the case of erroneous information furnished by its agents through an honest mistake," which was not the case in the suit then at bar. And the Appellate Division in the United Engineering case said "It may be conceded that paragraph 10 [the disclaimer clause] of the contract would afford protection to the state on a claim for damages because of an innocent mistake in the plans upon which bids were received." But though apparently the contractor, if he continues work, may not later collect damages because of the engineer's mistake (whereas he can if there was fraud), he does have the right to stop work and collect on a *quantum meruit* basis. The criterion was thus defined by Judge Bodine, "A mistake to warrant rescission of a contract must be material . . . and you must be satisfied that but for the mistake the contractor would not have assumed the obligation which he seeks to rescind."

In another federal court case on the Passaic Valley sewer, the appeals decision in the Tierney case, reported Oct. 23, 1924, p. 676, it was held that defective plans might give the contractor the right to collect, not only cost but also anticipated profit. No doubt a serious defect in the engineering plans is a "material mistake" just as much as faulty information on subsoil, even though the former may, as held by the Circuit Court of Appeals in the last-mentioned case, have the stronger legal aspect of a warranty (that the plans as drawn were capable of being executed and would accomplish the desired object).

Without splitting hairs over the precise meaning of warranty, mistake and misrepresentation, one may read in convincing manner from the cases cited that the owner and engineer are under certain obligations to the bidder and final contractor: they must make sure that the plans, specifications and information which they furnish the contractor and on which he obligates himself to do the work are both honest and reasonably correct. Judge Woolley's decision now emphasizes that a disclaimer clause is no refuge from the penalty for carelessness in studying the conditions of the work or for artful optimism in describing these conditions; the loss will be charged to the owner, not to the contractor. His decision and reasoning give substantial aid to the movement for better contracts.

What Is the Matter With Contracting?

1. Ignorance of Costs. 2. Poor Estimating. 3. No Distinction of Class. 4. Inadequate Engineering. 5. Hazards in Plans and Specifications. 6. Poor Judgment of Wage and Price Markets. 7. Disposition to Gamble. 8. Need of Co-operation and Organization

By Wm. Joshua Barney
President, Barney-Ahlers Construction Corporation, Industrial Builders, New York

THIS article is an endeavor to picture, in such a way that it will command attention, the unsound situation that exists today in the contracting business. Architects, engineers, bankers and owners — not contractors alone — have contrived to bring about the situation. All are here called upon, therefore, to work with contractors to improve conditions.

WHAT do statistics show? Manufacturing concerns made a profit of 5.5 per cent on their gross sales in 1923 before deducting taxes and dividends. The average profit for 11,000 contractors was 2 per cent—before taxes and dividends. The contractors of the United States make then less than 1¾ per cent profit after deducting federal and state taxes alone, without taking into consideration interest on paid-in capital. *On $1,000,000 worth of work, an average profit of only $17,500!*

Will any thinking man then claim that contracting is on a sound basis or that the contractor makes a sufficient profit?

Why is contracting found in such a precarious position?

Costs Not Known—To begin with, it is an unscientific business in many respects. It is probable that the larger percentage of contractors in this country do not know how to estimate. They know how to figure certain items reasonably well, but they do not know or acknowledge all of the costs that, entering into a job, should be figured. These omissions alone can make the difference between profit and loss on a construction job.

In estimating cost for labor, units are taken too often from good records on previous contracts. The average contractor in seeking work hopes for the best and cuts his bid on that basis. How many contractors can conscientiously answer "yes" when asked if they include everything that should be figured on a given building? How many of them can say that they have cost estimating forms that even provide places for figuring interest on investment, interest on loans, depreciation on plant equipment and other overhead items that have to be paid whether they are estimated or not?

Some have; and they may be inclined to say "Mr. Barney, you're not talking to us. You're talking to the inefficient contractors, and we think you're talking in the wrong place because most of them don't read *Engineering News-Record*." On the contrary, I am not talking only to the inefficient, even though they constitute a majority of contractors. I am talking to the efficient because leadership must come from them, not from those on the lower levels. The situation requires real leadership and education to show erring contractors the way to success—because too many of them are passing out of the picture. If their passing injured only themselves it would be bad enough, but their final struggles involve all.

Stop for an instant and try to think who of the contractors in business fifteen years ago are with us today.

What else is wrong with this business besides ignorance of fundamentals?

High Grade Work Not Appreciated—There is a lack of distinction between classes of contractors. It is a common occurrence to find, bidding on the same job, contractors whose past work and reputation are so far apart that the owner, architect or engineer hasn't a ghost of a chance of getting the same character of building from them all. Nobody thinks of comparing a Ford automobile with a Pierce-Arrow. The difference in standards and workmanship between Tiffany and the low class jeweler is recognized. They are not in the same class—they are not compared. But few and far between are the owners, architects and engineers who make a real distinction between contractors. The distinctions of class among contractors are not defined clearly enough.

What happens time and time again when a building contract is up for consideration? Several good contractors are invited to submit bids. The figures are: $250,000, $260,000 and $265,000—maybe more, maybe less, due largely to differences in interpreting specifications. Then what happens? Maybe the low priced contractor walks in of his own accord. But often he is invited in. At any rate, there appears upon the scene a contractor who does not know how to figure, who does not build as well as these other contractors, who is not financially as reliable as they are, who has not as good a reputation, who has a reputation of high charges for extras. He lays down a bid of perhaps $220,000 or maybe even $200,000. There may be several low grade contractors. There have been instances in New York, within the last few years, where as many as thirty-five contractors either have estimated or have sought the opportunity to estimate on a single factory building.

There have been instances where architect, owner or engineer has said, "I have estimates from several good contractors, but I have also called in some others. Their prices are very much under yours." An owner will put it this way, "These other contractors may be lower class, but they agree to build on the same specifications. My architect or my engineer gets a fee for seeing that they do good work. He will be on the job. I do not have to pay your prices unless you want to come down near the other fellow's level."

It is happening all the time. Sometimes it is the owner who does it, sometimes the architect or engineer. Sometimes the banker or financing organization has a hand in it. Each must take his share of the responsibility. Somebody in the situation who is supposed to be on the owner's side ought to have the courage to say, "This thing you are doing is wrong. These bids are not

for the same thing. You can't compare this low grade estimate with one of a reliable concern that is financially responsible, that will build well, build promptly, and be reasonable on changes. It isn't fair, and in the end it is not economy. Have all the competition you want. But do not mix up irreconcilables. If you want a cheap type of work, decide that, then keep out the good contractors. But if you want a good type of work, if you want real economy, do not let the low grade contractor set the pace."

"It is probable that the larger proportion of contractors in this country do not know how to estimate."

Price is not so flexible that there can be a very great variation without an actual difference in quality.

Assuming that the specifications are understood, wide variation means one of two things—either it is going to cost the contractor very close to the estimated price, or else the man who estimates has in mind to do inferior work, skimp and short-cut where he can, take longer, and charge considerably more for extras than he should. There is also the possibility that he may not finish the job.

This condition could not exist if owners, architects, engineers and bankers were more conscious of the fact that there are various classes of contractors, and that a Class A contractor should not be compared with a Class C or D contractor.

Engineering Assistance Inadequate — Speaking particularly of the industrial type of building, and approaching the subject with some hesitancy, I want to say that the contractor does not have, as often as he should, the benefit of the service that a good architect or engineer can render the owner. The architect and engineer are not sufficiently appreciated by the owner. He looks upon their fee as an extravagance. This places the architect or the engineer upon a price basis. It tends to turn his mind to justifying his fee by cutting costs to the bare bone—by shopping the job too close. It leads him into inviting the Class D contractors to figure against Class A and then using the Class D contractor's price to batter down the Class A contractors to whom he really wants to give the job.

You may say "Class A contractors do not have to come down or bid closer because of this competition." The Class A contractors cannot always help themselves. Their business is seasonal. They must maintain a reasonable volume. They may pass up a number of contracts, but sooner or later they come face to face with the necessity of operating in this kind of competition.

"Price is not so flexible that there can be a very great variation without an actual difference in quality."

Contractors all over the country should see the wisdom of setting up real codes of ethics and platforms for estimating work, executing contracts and keeping costs thereon. In this effort they deserve and should have the hearty support of architects and engineers.

So much for the exordium. Now for the evidence.

Some Causes of Profitless Contracting—Let me tell some of the things that are being done in New York, of how jobs are being estimated in comparison with how they should be estimated, about omissions and mistakes that account in no small measure for the confusion of competition, for the passing out of the picture of many contractors—things that have brought the contracting business to a point where it is not an attractive business from a profit standpoint and where contractors' accounts are not attractive to banks.

In telling some of the things we have learned from the preliminary study of the New York market, I am confining myself to one specific type of construction, namely reinforced-concrete buildings, mostly of industrial character, such as factories, warehouses, etc. I quote from a recently completed committee report which dealt with buildings contracted for during 1923:

> It is a matter of common knowledge that a large number of reinforced-concrete building contracts were entered into during 1923 on a basis which failed to yield a profit to the contractors. In fact, four or five contractors have practically withdrawn from the market on account of losses suffered on contracts made in 1923. These losses may have been due in part to inefficient handling of the work, but it is probable that a large amount of work was contracted for at figures which could not possibly have yielded a profit even under the most able management.

"Stop for an instant and try to think who of the contractors in business fifteen years ago are with us today."

It should be borne in mind in considering the foregoing paragraph that 1923 was not a depression year in the sense that 1921 was. While it is true that an unfavorable labor situation existed in the spring and summer of 1923, it was a condition that forecast its coming early in the year so that everyone had ample opportunity to consider it and proceed accordingly. Therefore, the significant point is that contractors seeking work of the character referred to allowed themselves to be led by competition and shopping into taking contracts at prices which "could not possibly have yielded a profit even under the most able management." Continuing, the committee's report says:

> The causes may be classified as follows: (1) Lack of knowledge of costs; (2) errors in estimating; and (3) failure to foresee conditions in the labor and material markets.

Ignorance, Inefficiency, Poor Judgment—Studying these three causes, they may be briefly summed as follows: The first is due to ignorance and improper cost keeping methods. The second is due to inefficiency, carelessness and failure to give proper consideration to dangerous items in plans and specifications. The last is due to poor judgment on the part of the contractor who ignored the ominous warnings and rumblings so plainly audible in both labor and material markets. The committee goes on to say:

> One contractor may estimate too low because he has not had enough experience on reinforced-concrete construction to know what it costs. Another contractor may have had considerable experience but may have kept such incomplete cost records that his experience is of little value in estimat-

ing new work. In either case the result is the same, a loss to the contractor who does the work and a loss to some other contractor who might have secured the contract at a fair price.

Cost records are of no value—or at least of very little value—unless they are the product of a cost-keeping system which is complete and subject to the same rigid balancing requirements as a first-class bookkeeping system. A unit cost for placing reinforcement which is obtained by dividing the total cost for one day by the total tonnage placed that day is of little value for two reasons—first there is no check on either the total cost or the tonnage; second the resulting unit cost is a special cost for one day and not an average for the job. An average unit cost for a job may easily be twice as great as a unit cost for one day taken when the job is under full headway. Under a proper cost-keeping system all expenditures for the account of a given contract must be charged against that contract and the charges must be properly classified; the cost of all labor, every item of materials and all sub-contracts and other expenses of whatever nature must appear under the proper classifications and the sum of the amounts under all classifications must equal to total cost of the work as it is shown on the books.

"The contractor does not have as often as he should the benefit of the service a good engineer or architect can render the owner."

The other expenses of whatever nature referred to in the previous paragraph are often sadly neglected in putting together an estimate. How many estimates include allowances for temporary power wiring, temporary water piping, job telephones and telegraph charges, job travelling expense, tool-house man and wear-and-tear on the plant, not to speak of the many items covered by the all-embracing term "overhead."

By the term "overhead" we do not mean field organization, insurance or definite items of that nature which cannot be omitted from any intelligent estimate except through gross carelessness. We refer to main office expenses, the classification of which is open to argument. There are two kinds of "overhead" expenses: (a) expenses that do not fluctuate immediately with the volume of business, such as rent, salaries of officers and heads of departments and other steady time employees, and depreciation and taxes; (b) expenses which fluctuate with the volume of business such as salaries of draftsmen and clerks, telephone and telegraph charges, blueprints, stationery, postage, interest and bank loans. There is room for difference of opinion as to whether the items under (a) should be covered by a specific allowance in every estimate. There can be no denial that the items under (b) are as real a part of the cost of the work as labor and materials used on the job. On average work the cost of these items is from 1 per cent to 2 per cent.

The cost of winter protection is often given insufficient consideration. During the past winter there have been at least three serious failures of reinforced concrete attributed to lack of proper winter weather protection. This is not only bad for the individual contractor but bad for the industry. It is a simple matter to figure out the cost of canvases necessary to enclose a sufficient area of the work, the cost of salamanders and coke and the rental of a boiler for heating the water and dry aggregates. The cost of labor can only be estimated by experience. The four construction companies whose representatives are signing this report will gladly furnish information from their own experience to any contractor desiring to protect his work properly under winter weather conditions.

"Estimating errors fall into two classes: clerical errors either in quantities or extensions and failure to interpret specifications."

Why Estimates Are Wrong—Expressed in a simple way a contractor's estimate represents the supposed cost of the work, plus his profit. Since the government figures show that the net profit of the contractor is less than 1¾ per cent on the average, it is obvious that this low percentage of profit—about one-third the profit made by the average manufacturer in the United States—is due in no small measure to failure on the part of the average contractor to include everything that should be included in estimated costs. His profit dwindles away because of "errors and omissions" in estimating. Obviously, too, the more careless the estimate, the more careless will be the resultant workmanship on the contract since the contractor who gets a job on the basis of a careless estimate will know it long before the job is completed and he will skimp and cut wherever he can in an effort to get out whole. The poorer the contractor and therefore the more careless his estimate and the lower his bid, the poorer will be the result. Continuing the committee's findings:

These errors fall into two classes: (a) Clerical errors either in quantities or in extensions; (b) failure to interpret specifications.

(a) Clerical errors are due to carelessness and inexperience on the part of an estimator, or failure to have estimates checked. It is fairly easy to make a mistake of $10,000 in an estimate. A small part of this sum added annually to the budget of an estimating department would make the risk of such a mistake almost negligible. Employ good estimators and have their arithmetic checked by another man.

"Profitless contracting is due to lack of knowlege of costs, errors in estimating and failure to foresee conditions in the labor and material markets."

(b) The amount of gamble which many contractors are willing to take, either consciously or carelessly, through bidding without reservations on an ambiguous or unfair specification is surprising. A city job involving over two million dollars came out for bidding during the past winter. Several clauses in the specifications were ambiguous, and three or four days before the opening of the bids one of the signers of this report wrote to the department in charge of the work asking seven questions, all of them so important that the nature of the replies would affect the estimate to the extent of about $100,000. These questions were answered in the form of a bulletin sent to all contractors bidding, and the form of the bulletin was such that it was evident that none of these questions had been asked by any other bidder.

It seems to be the case that many contractors turn over plans and specifications to an estimator without having them studied by a responsible executive; or, if such a study is made, it is made just before the bid is submitted when time is lacking to develop a clear picture of the problems involved. No contractor can safely submit a bid unless specifications have been read and plans studied thoroughly by an experienced and responsible executive.

Unfair Specifications—A word regarding ambiguous or unfair specifications cannot be amiss. There are enough uncertainties in construction work to make any contractor lose sleep even if everything is clearly understood. Add to this fact the ambiguities and

equivocations of the English language and you have the possibilities of a maximum of trouble and loss. Why should the contractor be asked to take chances on all sorts of things? He doesn't pick the site. He has at the most only a small profit on the job. If he absorbs the loss due to encountering quicksand or some other foundation condition, it comes out of his pocketbook with no chance to make it up on that contract. If the owner who selected the site takes the loss, the building that he erects affords him the opportunity to recover on the increased cost of the structure in the years of use to which the building will be put. One of the most important statements that could be put in a code of practice for the contracting business would be: "It is not up to the contractor to take chances on conditions which are beyond his control such as unknown or unforeseeable rock conditions, quicksand, ground water, false bottom, etc." When all contractors learn to say "no" to a proposition on which they take the chances and absorb the loss due to such conditions, the contracting business will have taken a long step forward.

Prognosticating Markets—The third cause assigned by the committee, "the failure to foresee conditions in labor and material markets," is a more difficult one for the contractor to overcome. Fortunately, however, there are available today a number of efficient services that study and report on business in general and the construction business in particular. By alertness and making it a point to keep on top of the economic conditions that affect the contracting business directly or indirectly, the contractor can proceed with far greater intelligence and far better judgment than by ignoring them. It is a simple fundamental out of past experience that the line of business moves upward and downward over a course of years, influencing the interest rate, labor efficiency, material prices, etc. It is a simple matter to know what to do under the extreme of these conditions, but more than this is necessary—the line does not move in a regular way. It dips upward and downward on its way up, and upward and downward on its way down. Therefore it requires careful watching on the part of the contractor in order to know what to do in an estimate for a building that is going to be erected in the next four to six months. The committee has this comment to make:

> It is possible for a bidder to protect himself by firm quotations from material dealers and sub-contractors on practically all materials and sub-contracts entering into an estimate. He cannot protect himself against labor troubles, labor inefficiency, and delays due to shortage of materials and labor and other causes. The best he can do is to try to foresee the conditions which will affect the supply of and demand for labor and materials at the time when the work will be under way. Fortunately the information upon which he can base such a forecast is more available than ever before, and is being published by various sources in such a form that it can be interpreted without the aid of a statistical expert. Contractors should form the habit of studying conditions affecting the building industry. If they had had this habit a year ago, when a clear warning was sounded of the trouble ahead, there would have been less grief when the annual reports for 1923 were completed.

Why Not Improve Conditions?—In closing, the writer submits that such conditions as are indicated by the facts herein given are not in the best interests of owner, architect, engineer, banker and contractor, and therefore they are not in the best interests of the general public. While it is true that competition is in reality the survival of the fittest, it is also true that the passing out from business of a large number in any given industry has a harmful effect not only upon that industry but also upon the industries and professions to which it is allied and the whole economic structure. Turnover of concerns will always be with us. It is not in the normal turnover or the normal failures that we are particularly interested, but with the *abnormal* conditions of the contracting field. That the situation can be improved by co-operation and education has been evidenced in other fields.

I have in mind another business in which local associations were formed and later a national organization. One of the first things done was to define what constituted good practice and what constituted unwise practice. Each general classification under these two broad headings was assigned to a committee to study and report upon. As a result the character of the service improved considerably, the evil practices have been minimized, the business of the members of the association (who constitute a minority—there being fewer in the association than outside) has increased by leaps and bounds. Competition is keener than ever but along sound and constructive lines and it is significant that in the last seven years not a single member of the association has met with financial disaster.

Co-operation, study and constructive thinking can do the same thing in the contracting business. It requires organization rather than individual effort. I hope the day is at hand when contractors with similar interests will organize in each locality and study the fundamental problems of their business.

Tidal Power Scheme in England

IN VIEW of the interest in tidal power that has been aroused in this country through the publicity recently given to a proposal to develop power from the tides in the Bay of Fundy by controlling the flow from Passamaquoddy Bay, the following editorial from *The Engineer*, London, on the Severn River is of note:

> At the end of 1920 the civil engineering department of the Ministry of Transport formulated an ambitious scheme for the construction of a tidal hydro-electric station on the river Severn. The scheme contemplated a station with a capacity of a million horse-power and capable of giving an average of half that amount over a ten-hour day. About the same time the Water Power Resources Committee studied the same problem and placed the average power obtainable at 260,000 kilowatts. No estimate of the cost of developing the Severn's power resources was given officially, but it was suggested by outside authorities that it would amount to anything from eight to thirty million pounds. The scheme did not meet with much approval. In February, 1921, a joint meeting of the Institutions of Civil, Mechanical, and Electrical Engineers was held in Birmingham to discuss the proposals, and the majority of those who took part in it expressed the view that the capital cost would be far too great to enable the current generated to be sold at a reasonably competitive price. So far as the majority of engineers were concerned, the scheme soon afterwards appeared to have died a natural death. In 1924, however, Mr. MacDonald's Government revived interest in it, . . . a preliminary study was made . . . and a committee was appointed to carry the investigations a stage further. On the results of the committee's geological and hydrographical studies Sir Maurice Fitzmaurice and Sir John Griffith were to be invited by the Government to submit to it a joint report on the possibility of constructing the barrage. . . . Last week it was announced the committee's report had been submitted and was being considered by the Government. Up to date, it was added, £2,562 had been expended on the inquiry, and if the Government decided to proceed with the investigation the total cost of the complete inquiry would be from £70,000 to £90,000.

Driving Wanaque Tunnel for North Jersey Water Supply

860-Ft. Tunnel to Carry Supply Line Under Overflow Channel of Dam—Power and Concrete Plant Existent at Site

THE SUPPLY line leading from the Wanaque reservoir in northern New Jersey south 25 miles to Newark is to comprise cut-and-cover conduit, tunnels and pressure pipe. A 2-mile section of this aqueduct, known as the Great Notch Tunnel, was described in *Engineering News-Record*, Nov. 6, 1924, p. 744. The present article describes a similar tunnel, 860 ft. long, the construction of which is being carried on as an operation minor to the building of the reservoir dam structures as described in *Engineering News-Record*, Aug. 13, 1925, p. 252.

It is partly in connection with this subordination to the dam-building operation that this work is notable. No separate plant, other than a small blower outfit, has been necessary, since air, electric current and concreting facilities are available from the other construction operations. Also, 15 men constitute the labor force on the tunnel, whereas a total of about 500 men are engaged in the other operations.

The aqueduct leaves the lower gatehouse of the Wanaque dam through 250 ft. of cut-and-cover conduit connecting with the north portal of the tunnel. This tunnel carries the water on a slope of about $\frac{3}{8}$ in. in 100 ft. under the overflow channel of the dam, and connects with 590 ft. of cut-and-cover conduit on the south, the construction of which will complete aqueduct structures on this contract. This original plan has been tentatively altered for the tunnel to extend about 100 ft. further south, thus cutting down the cut-and-cover section to 490 ft. It is believed that such a procedure will prove cheaper since the removal of the overburden at the first-planned south portal will require considerably more excavation than will be the case 100 ft. further south.

Rock Formation—The rock bore, as shown in Fig. 1, is about 11x11 ft. for a horseshoe lining 9x9 ft. inside. The estimated excavation quantity to line *B* is 3.9 cu.yd. per lineal foot, or a total of about 3,400 cu.yd. Fig. 2 is a profile of the tunnel. It is being driven wholly from the north end. The rock formation encountered here and for the 500 ft. of the tunnel now completed is a granite gneiss, sound except for usual jointing. A major joint, plainly visible at the exposed face of the portal, is inclined at about 30 deg. to the vertical, and has so far exactly followed the line of the tunnel bore. It has, however, stood up well as only two medium-sized slips have occurred during blasting. In fact, the first 200 ft. of the tunnel broke nearly perfect along the *A*-line (Fig. 1) inside of which no rock must project.

The preliminary geological survey showed the rock structures adjacent to the two portals to be quite unlike, and that timbering might be necessary for some distance in from the south portal; the formation found here was gray rock containing much ferro-magnesia. Designs were therefore prepared for both timbered and untimbered sections (Fig. 1); however, no timbering has been necessary thus far.

Tunneling Procedure—The driving of the tunnel was started from the bottom of a drift sunk normal to the tunnel line about 25 ft. in from the north portal. Such procedure was thought necessary because of rock conditions. It had been decided that the portal should be as near as possible to the station 2+50 shown on the profile (Fig. 2). Since the rock at this point was badly weathered and the large inclined joint looked rather unstable, the contractor felt that slides were likely to occur should the tunnel be driven directly into this weathered rock; and, as a result, the portal might be some little distance from its planned location. Work, therefore, proceeded both ways from the bottom of the drift.

The excavation process is to blast out a full face, load the excavated material into 1.3-cu.yd. side dump cars with an electric power mucker and haul the rock to a spoil dump just outside of the portal by means of a storage battery locomotive. The spoil bank forms part of the downstream fill for the Wanaque concrete core-wall dam. The only governing condition is that the spoil bank shall not exceed a certain elevation on account of the aeration basin that is to be installed

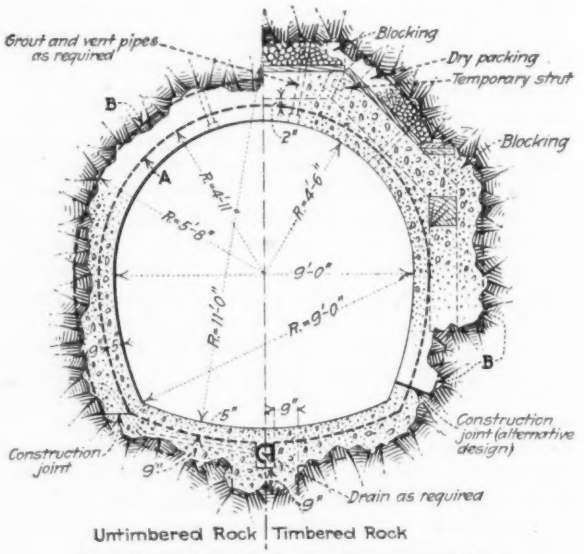

FIG. 1—WANAQUE TUNNEL SECTIONS

between it and the dam. The construction operations are divided into three 8-hr. shifts, two devoted to drilling and the third to blasting and mucking.

Drilling Methods—Drilling is carried on by two drills, each mounted on a vertical standard and using 6-wing butterfly and Carr patented chisel bits. Changes in drill steel are made every 2 ft. and a 12-ft. length is the last used; the diameter of the steel is reduced $\frac{1}{4}$ in. for each 2-ft. length from the initial $2\frac{1}{2}$-in. bit. The 6-wing butterfly bit is used on the first length since it picks up a hole on a jagged face of rock more accurately and readily than a cross bit.

When drilling was first started, cross bits were used after the hole had been opened but were found to rifle the holes thus keeping the drill steel from revolving and causing it to bind. Another disadvantage was that the cuttings would not readily wash out; thus the bit would grind on the cuttings instead of making effective headway. With the light-weight drills used, it was essential that the drill steel revolve if it was to cut efficiently. The Carr patented chisel bits have

now been adopted for use after the hole is started with the butterfly bit. These have proved very satisfactory. Holes are drilled about 11½ ft. deep and 28 to 32 min. is the average time required for each hole. A drill gang consists of two drillers, two helpers, and a heading boss. The full face of 34 holes is drilled from one setting of the standards. Fig. 3 shows the drilling diagram and order of firing. Dynamite of 60 per cent gelatine in 8-in. sticks of 1¼-in. diameter is used.

Excavating Methods—An advance of approximately 10 ft. is made at each shot, the rock flying back about 100 ft. where mucking commences. An average time of about 20 min. is required for clearing the gases, although recently a number of mud seams have been encountered which hold the gases for a somewhat longer period. The charge used breaks the rock to a very satisfactory size for the power mucker. This is a Conweigh machine whose shovel discharges the muck onto a conveyor belt which is an integral part of the machine; this belt discharges into the dump car at the rear. The machine has proved very efficient in this small-section tunnel, materially contributing to the 55-ft. average advance made each week since the driving commenced.

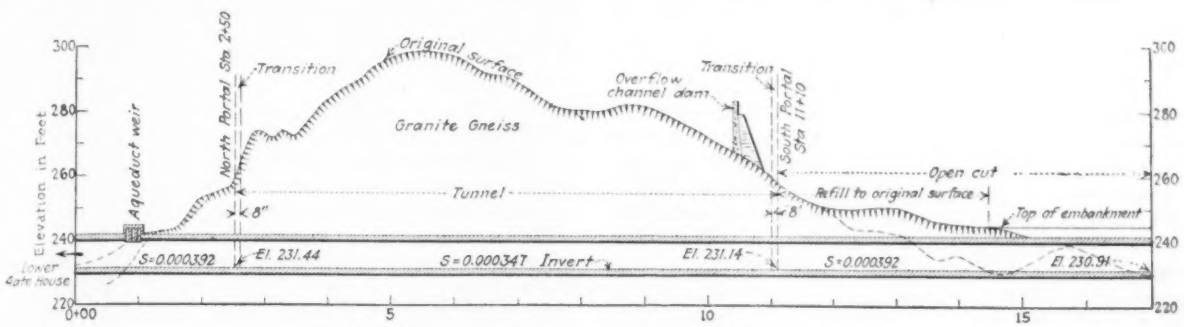

FIG. 2—PROFILE OF TUNNEL NO. 1 FROM WANAQUE DAM

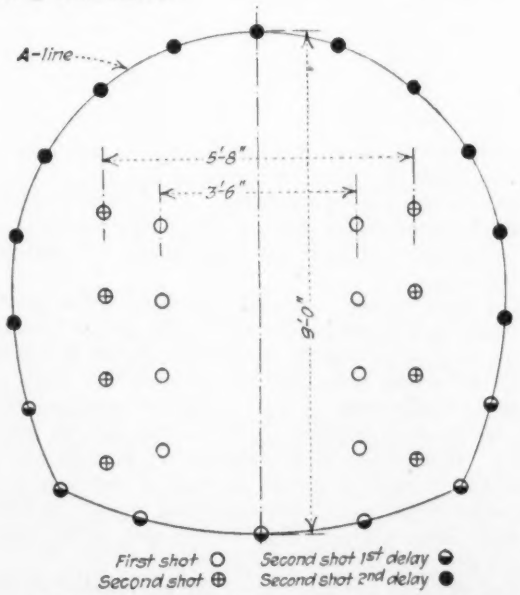

FIG. 3—DRILLING AND BLASTING DIAGRAM

The two vertical lines of holes are drilled for V-cut and fired first as shown; this relieves the strain on the peripheral holes so that the final break occurs as near on the *A*-line as possible. Approximately ten sticks of dynamite are used for each hole.

The rock blasted at one charge, consisting of 30 to 40 carloads, is mucked and removed in about 5 hr. by five men—shovel operator, locomotive operator, two muckers and a heading boss.

Not enough water has been encountered to make drainage absolutely necessary. However, temporary sumps are placed in the bottom at frequent intervals from which pumping is accomplished by a small direct-acting pump operated by air.

Plant—Since the driving of the tunnel is a minor operation on a large construction job, the plant for the tunnel operation was practically present when construction began. Electricity and air have, of course, been used in the dam construction. Air for the tunnel is at 90 lb. per sq.in. pressure at the compressor 3,000 ft. away and on the far side of the dam. There is at the portal a small blower plant for delivering free air to the men and for clearing out the gases. There is also a blacksmith shop.

The pipe system is against one side of the tunnel and consists of a 6-in. low-pressure air line from the blower, a 4-in. air line for the drills, a 2-in. water line for the drills, and a 2-in. drain water line from the pumps. Electric current is brought into the tunnel on a three-wire system—two for light and one for blasting. These are supported on square pins near the top of the walls of the tunnel. Lights are placed at about 35-ft. intervals.

The railroad consists of 30-lb. rails set at 30-in. gage on wood ties. Only one muck car is used at the present time, but preparations are being made to shift the track to one side of the tunnel so that empty cars may be set off to allow loads to pass. This will be effected by block and tackle, as the weight of the empty cars is only about 600 lb.

Lining—The plan for lining is to concrete the invert; then with 40-ft. steel forms traveling on the invert the sides and roof are to be lined. Concrete will be mixed at the central mixing plant used for the dam structure. This plant is about 150 ft. above the north portal and delivers onto belt conveyors running along the top of the Wanaque dam core wall. Concrete will be chuted from here directly into batch cars on the tunnel tracks, from where it will be transported to the forms by the storage battery locomotive.

Personnel—The tunnel is being constructed for the North Jersey District Water Supply Commission with Arthur H. Pratt, chief engineer, and N. C. Holdredge, assistant chief engineer in charge of construction. Clifford F. MacEvoy, of Newark, is the contractor with Robert Parker as general superintendent.

Close Water Control Important in Alumina Cement Concrete

Tests Show That Concrete Made From High Early Strength Cement Can Readily Be Affected by Excess Mixing Water

By P. H. Bates
Chemist, U. S. Bureau of Standards, Washington, D. C.

IN CONNECTION with the routine testing of cement and concrete at the Bureau of Standards, two series of specimens were made and tested in which was brought out strikingly the effect of water upon the strength of concrete made from high alumina cement. To a less degree there was also shown the effect of the grading of the aggregate. These data, although meager, are presented herewith to bring to the attention of prospective users of these interesting cements the need of close control, if the maximum possibilities of the cement are to be secured.

The first series of specimens (Table II) was made as a preliminary study to determine the design of a concrete to be used in an extension of the study of high alumina cements reported in the bureau's Technologic Paper 197, "The Cementing Qualities of the Calcium Aluminates." In this preliminary work a commercial cement of this type was used in combination with local sand and gravel, the properties of which are indicated in Table I. Three ratios of cement to aggregate were used and three percentages of water for each ratio. These different amounts of water were chosen to give about the same flow with each mixture, but no preliminary trials were made to determine what the amounts should be. The first mix of 1:2.6:2.8 was made with the different water contents and judging from the character of the aggregate and the contemplated ratios, an amount of water was used in the other mixes which it was thought would give about the flow used in the first one.

It should be noted, however, that with the drier consistencies no true flow was obtained. The truncated cone of concrete on the removal of the mold remained standing erect with practically no slump or deformation, and, on jarring the table by dropping, the pebbles rolled out of the mass without any flow of the mass as a whole.

This result was especially true of those mixes which were notably deficient in sand or uniform grading and applied particularly to the flow indicated for the dry consistency in the first series of test pieces.

The second series of specimens was made as a result of a contractor's not obtaining the desired result in the making and driving at the end of 24 hours of some high alumina concrete piles. An inspection of this casting led to the belief that too much water was being used and that the nature of the aggregate was such that the required workability could not be obtained without the use of this excess water. The test specimens were consequently made to determine these points. The aggregates and proportions as used on the work were employed with three percentages of water. As the sand in use appeared to have too high a percentage passing the finer sieves, two coarser sands were also used with the same coarse aggregate but with one percentage of water. This coarse aggregate also seemed to be largely of one size, between the ¾ and ⅜ screens, hence it was modified by the addition of some finer material as indicated in Table I.

In the making of the test pieces, only enough material (including the water) was weighed out to make one test piece. After thorough hand mixing dry, the water was added and the mixing continued. The flow and strength were determined for each of three specimens of the different mixes and the average values are presented in the tables.

The data require but little comment. The marked decrease in strength accompanying the use of too much water is evident. In the first series, in the 1:2:4 and 1:2.5:3.5 mixes using the dry consistency, there was a marked deficiency of water and the specimen could not be properly molded, owing to the lack of workability. In all other cases sufficient workability was obtained to permit of proper casting of test pieces and the effect of the use of the additional amount of water, in some cases not exceeding 0.5 per cent of the weight of the dry mix, stands out prominently.

The effect of the grading of the aggregates or their proportioning is not quite as evident. But in the first series the economy in the use of cement obtained by using the 1:2.5:3.5 mix instead of the 1:2.6:2.8 would

TABLE I—FINENESS AND WEIGHT OF SAND AND PEBBLES

	Per Cent Retained						
	Sand				Pebbles		
Sieve	*A*	*B*	*C*	*D*	*A*	*B*	*C*
1	....	....	....	....	0.0	0.0	0.0
¾	....	....	....	....	0.0	11.1	5.5
⅜	....	....	....	....	50.0	84.4	42.2
4	0.0	8.2	0.8	1.0	100.0	98.6	84.3
8	0.5	19.0	8.8	2.6	.....	100.0	100.0
16	3.9	33.0	32.0	12.2	.....	.....	.....
30	20.4	56.6	71.0	65.6	.....	.....	.....
50	74.8	82.6	94.4	99.2	.....	.....	.....
100	94.8	95.6	99.0	99.8	.....	.....	.....
Fineness modulus	1.94	2.95	3.05	2.80	6.50	6.94	6.32
Weight, lb. per cu ft.	112	107	102	104	102	103	105

Sand *A* and pebbles *A* were used in first series.
24-hr. tests of cements—pounds per square inch.
1:3 standard sand mortars.

Tension	Compression	
275	5,615	Cement used, Series *A*
351	5,715	Cement used, Series *B*

TABLE II—COMPRESSIVE STRENGTH 6 x 12-IN. PEBBLE CONCRETE CYLINDERS (FIRST SERIES)

All specimens broken at end of 24 hours. Sand *A* and pebbles *A* were used in First Series.

Proportions by Volume	Per Cent Water (of Dry Mix)	Flow	Lb. per Sq.In.
1 : 2.6 : 2.8	7.3	24	5,190
	8.4	47	4,790
	9.5	79	3,630
1:2:4	6.4	53[1]	4,260
	7.3	45	4,440
	8.8	74	2,620
1 : 2.5 : 3.5	7.0	53[1]	4,310
	8.0	54	4,335
	9.1	66	3,550

[1] Mix so dry that "crumbling" and not "flowing" resulted.

TABLE III—COMPRESSIVE STRENGTH 1:2:4 PEBBLE CONCRETE BY VOLUME, 6x12-IN. CYLINDERS BROKEN AT END OF 24 HOURS (SECOND SERIES)

Sand	Gravel	Per Cent Water (of Dry Mix)	Flow	Lb. per Sq.In.
B	B	7.2	25	3,825
B	B	7.7	38	3,345
B	B	8.2	52	2,945
C	B	7.5	30	3,705
D	B	7.2	40	3,975
B	C	7.8	24	3,280
C	C	7.6	28	3,250
D	C	7.5	30	3,700

justify the use of the former mix in the workable concretes and would entail no very marked sacrifice of strength. In the second series the regraded coarse aggregate, containing more fine material, required more water in order to secure the needed workability. As a consequence there was a slight reduction in strength, but there was obtained a distinctly more workable concrete, although this is not evidenced by the flow table results.

In view of the fact that there is a tendency to use this cement in certain cases on account of its high early strength the user should, in order to obtain the maximum in this respect, for which he is paying considerably more than if he were using portland cement, make preliminary studies of his available aggregates. The fine and coarse aggregates should be so graded and proportioned that the minimum amount of water would be required to develop the required workability. The use of excess water to obtain the latter quality, or a grading of aggregate that will require excessive water to insure this quality will result in a marked decrease in strength over that which the cement can produce in properly designed concrete.

Water Main Breaks at Congested Corner of Fifth Avenue, N. Y. City

A BREAK this summer in a 20-in. cast-iron bell-and-spigot water pipe at 42nd St. and Fifth Ave., New York City, tied up the subways underneath for the greater part of a day. A large section of the pavement was undermined and the subsequent repair operation has caused an increase in congestion on the surface and considerable re-routing of traffic for the past month. The corner is one of the busiest in the city carrying the bus traffic north and south on Fifth Ave. and street car tracks east and west on 42nd St., in addition to normal vehicular traffic.

The immediate cause of the break is unknown but according to W. W. Brush, deputy chief engineer of the Bureau of Water Supply, there were at least two prominent contributing conditions: (1) When the old subway was built in 1905, a large amount of timbering was placed under the pipe system, and the fill that was used to cover the subway was probably rather loose; upon examination after the break, the timbers were found to be badly decayed and much of the loose fill material washed away; (2) the very heavy load imposed by the traffic that this pipe system has had to carry. Mr. Brush's theory is that the pipe failed as an arch. The crack developed longitudinally from a joint, which was loaded with a heavy bank of duct pipes in addition to the earth, the pavement and the traffic.

The repair work was considerably more extensive than was required to restore the broken main, since the forced opening of the street gave an excellent opportunity for other needed repairs. The pipe system at the break consists of two 48-in., two 36-in., one 20-in. and one 12-in. pipe running north and south and two 12-in. pipes running east and west beneath the other pipes. The subway roof is 22 ft. below the level of the street, and the new extension of the Queensborough subway, now under process of construction, passes several feet to the south of the point where the break occurred. The underground space was, therefore, very crowded and repair operation was necessarily slow. Reinforced-concrete beams were placed 8 ft. c. to c. for supporting the inverts of all of the north and south pipes. Each beam, in turn, was supported on three 12-in. concrete piles, which extended down to the roof of the subway.

Fortunately, little underpinning was necessary, since the street car tracks at 42nd St. are carried on a column-and-I-beam structure that presumably rests on the roof of the subway. Investigation showed that 42nd St. was undermined 40 to 50 ft. in each direction from Fifth Ave.

WATER MAIN REPAIR WORK UNDER CONGESTED CONDITIONS

A later break, at Ninth St. and Fifth Ave., was due to the settling of a 48-in. pipe onto a lug of a 16-in. high pressure line that ran underneath. The pounding of the overhead traffic load was localized at this lug with a resultant shearing of the pipe. These breaks and others all seem to result from the traffic load that the pipes are required to carry in excess of that for which their supports were designed.

John F. Mead, superintendent of repairs, Borough of Manhattan, was in active charge of the repair work.

French Railway Pierces Vosges Mountains

Following upon the armistice and the need of closer and more direct communications between Alsace and France came the question of a tunnel through the Vosges Mountains, there having been no rail communication previously owing to strategic prescriptions of the war department. The Paris-Strasbourg line passes over the Col de Saverne from which point southward to Belfort there is no other rail communication; three mountain passes carry the highways over crests varying in altitude from two thousand to thirty-five hundred feet. The new line will continue that from Saint Die to Saales. The length of the connecting line will be 25 kilometers of which the tunnel at Lubine, near the Col de Salles, will have a length of more than a kilometer and a half. The first kilometer of the tunnel is already driven and work is progressing rapidly so that the opening of this important means of communication between two contiguous French districts is expected to be in 1927. It will reduce the distance from Strasbourg to Saint Die from 166 to 79 kilometers and will give the valley of the Bruche a double line communication of first rank.

Santa Fé Engineering Quarters in New Office Building

Layout of Engineering Department and Drafting Room—Window Blinds Give Ventilation and Shade—Filing System for Drawings and Documents—Filing Cases in Vault

IN THE new portion of the general office building for the eastern lines of the Atchison, Topeka & Santa Fé Ry. Co., at Topeka, Kan., the engineering headquarters occupy most of the fourth floor and cover an area of about 15,000 sq.ft. A view of the west front and north end of this building is given in Fig. 1. Two main entrances are provided, near the ends of the west front, in order to avoid congestion, each entrance leading to a lobby with a bank of elevators.

Engineering Offices—In the layout of the engineering department, shown in Fig. 2, the chief engineer of eastern lines has an office, 23x19 ft., at the corner of the building. Extending along the main front are the clerks' office (with public entrance) and rooms for the chief clerk, heating engineer, architect, architect's draftsmen, right-of-way agent and the land group of the valuation department. On the opposite side of the corridor are the engineering department's file room and the office of the supervisor of water service, together with a small room for storing samples of building material. The wing is occupied by the office engineer, the engineering drafting room and the valuation department, with an office for the valuation engineer. Both the drafting room and the valuation department have large fireproof vaults, as shown. A pneumatic tube system for handling messages to and from the telegraph office and a buzzer system to various parts of the engineering department offices, save considerable messenger service.

Drafting Room—The engineering drafting room, Fig. 3, is long and narrow, 98x23 ft., with large windows along the north side, so that outside shades are not necessary. The windows are provided with venetian blinds, which consist of adjustable wood slats folding together; these blinds, operated by cords, may be raised and lowered as desired, and the slats may be set at different angles, to exclude sunlight without excluding air and without unduly darkening the room. These blinds, which are used also in the offices, as shown by Figs. 3 and 4, are of special advantage in a hot climate. For the main electric lighting system there are two rows of 100-watt lamps, spaced 8 ft. 8 in. apart in each row and enclosed in opaque globes, giving a diffused light. There are also numerous plugging receptacles so that desk lights can be used, if required.

At the windows, and arranged at right angles to the north wall, are the main drafting tables. These tables are 8x3½ ft. and each is equipped with a cabinet hung on one end to provide space for supplies and drafting instruments. A long counter or table is provided for handling long drawings and beneath this is filing space for station lease plans. Drafting room supplies are kept in the vault, in charge of the vault man, while stationery supplies are kept under a long counter in the bill and voucher clerk's room.

Battleship linoleum covers the concrete floor of the drafting room, the walls and ceiling of which are painted white. Wash bowls are provided in the room. In the vaults the floor has a concrete finish.

Filing System—An interesting feature of the engineering office is the manner in which the maps, plans, valuation records, letters and other documents are filed and arranged. The maps and miscellaneous drawings in current use are filed in a vault adjacent to the drafting room, this vault being 27x33 ft., and 10½ ft. high. Most of the drawings and maps are rolled and placed in pasteboard tubes 36 in. long, with cap on one end, each tube having the number of the drawing it contains indicated on the cap. These tubes are filed

FIG. 1—OFFICE BUILDING OF SANTA FÉ RY. AT TOPEKA

in pigeon-holes 6x10 in., with twenty tubes to each compartment. The general design of the filing cases is shown in Fig. 5, while their arrangement in the vault is indicated in Fig. 2.

In designing the cases in the vault, which are all of steel, they were so arranged as to provide 500 numbers for each horizontal tier of pigeon-holes. This arrangement is of material assistance to the vault man in locating drawings to be taken from the vault and in filing those returned. Drawer space is provided at the bottom of the cases for flat filing of small exhibit sketches and numerous other small data. There are also vertical filing cases for documents, contracts, steel bridge blueprints and other records, while considerable steel shelving is provided for field-note books. Vertical filing for large plans or drawings is not used by the engineering department.

Filing cases *A*, *B*, *C*, *D* and *E* are to accommodate drawings filed in the pasteboard tubes. They vary in length, but are all 9 ft. 10 in. high, with a width of 3 ft. for the single cases and 6 ft. for the double cases. At the bottom of the cases are drawers 42x34 in., 2½ in. deep, each with a 6-in. hood at the back to prevent the contents from slipping out. Some of the drawers are subdivided to give three or four compartments in each drawer.

Case *F* has a lower part 6 ft. wide for a height of 3½ ft., then 3 ft. wide, thus forming a 3-ft. counter on one side. This case provides for extra long pigeon-holes for long drawings, also space under the counter for keeping heavy record books. Case *G* provides space

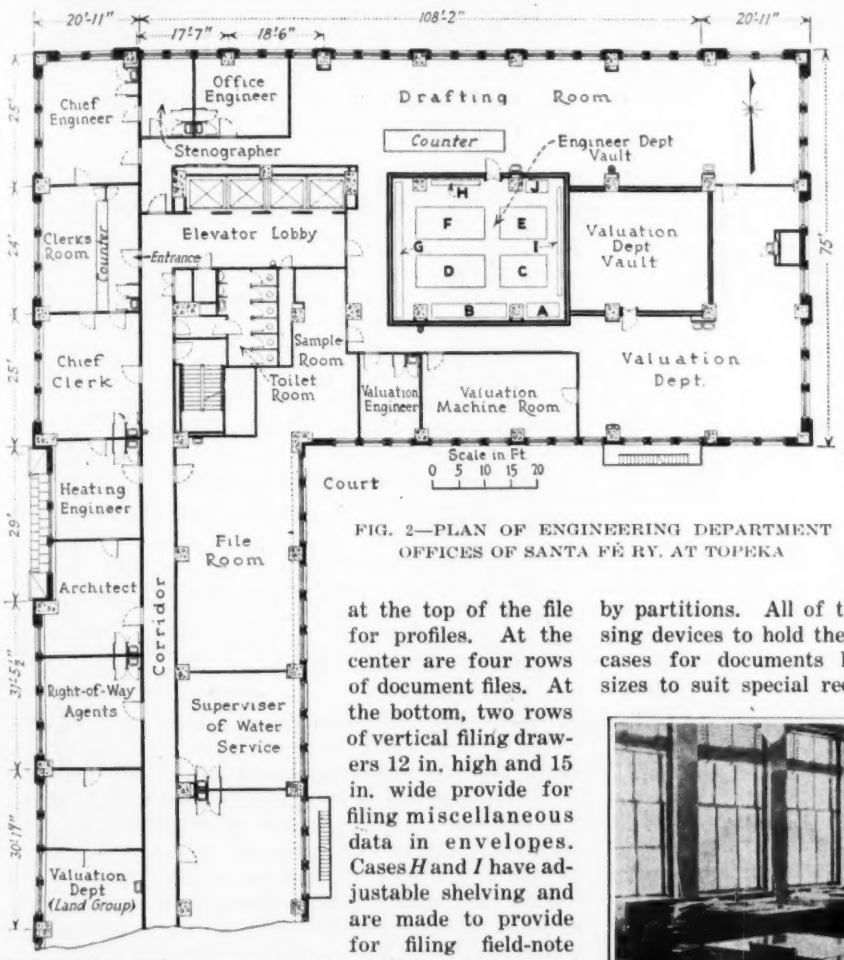

FIG. 2—PLAN OF ENGINEERING DEPARTMENT OFFICES OF SANTA FÉ RY. AT TOPEKA

at the top of the file for profiles. At the center are four rows of document files. At the bottom, two rows of vertical filing drawers 12 in. high and 15 in. wide provide for filing miscellaneous data in envelopes. Cases *H* and *I* have adjustable shelving and are made to provide for filing field-note books. Case *J* has compartments of different sizes and shapes to accommodate various drafting room supplies and is provided with doors.

One man is assigned to have charge of the vault in the drafting office; he looks after the filing of new drawings, keeps a record of all those taken out and

FIG. 3—DRAFTING ROOM, SANTA FÉ RY. OFFICE
Overhead ventilating duct at left. Collapsing blinds in windows.

replaces those which are returned. In order to take care of future requirements, the vault space and fixtures were designed to provide accommodations 50 per cent in excess of the present requirements.

Valuation Records File—The vault provided for the valuation department is 27 ft. x 22 ft. 7 in. and 10 ft. 6 in. high, and contains steel filing cabinets and shelving to accommodate numerous valuation records and map sets. Vertical filing for large maps is provided by cases about 4x5 ft. and 6 ft. 8 in. high, with folding doors on the narrow side and rails for trolleys with hooks to which are attached the bound backs of map sets. This arrangement, shown in Fig. 6, gives 5½-ft. height under trolleys.

Flat filing for drawings is provided by double cases about 6x5 ft. and 6 ft. 8 in. high, with drawers on both sides. These drawers are 28x66 in. inside and 2½ in. deep, with a label holder on the front and with a 6-in. hood at the back to prevent the contents from slipping out. A few of the drawers are divided into compartments by partitions. All of the others have spring compressing devices to hold the contents in place. Other filing cases for documents have compartments of various sizes to suit special records or forms and have either

FIG. 4—ROOM OF VALUATION DEPARTMENT
Note adjustable venetian blinds in windows.

fixed or adjustable shelves. A part of the space allotted to the valuation department is taken up by a sound-proof machine room for the various tabulating and other machines. The letter-file room is provided with steel cases and the letter files are kept in steel file boxes.

Other Engineering Offices—In addition to the main engineering headquarters, the district engineer's offices are on the third floor and the signal engineer's offices on the ninth floor, occupying in all about 4,200 sq.ft. of floor area, while the timber-treating department has approximately 2,100 sq.ft. on the fifth floor. Blueprint work is handled by the reproduction department, which is located on the first floor of the older part of the building. This department also makes reproductions of tracings, photostats of drawings or documents, and blueprint copies of reports by the various departments. It also operates a multigraph machine. Titles for important drawings are usually set up and printed on the drawings by the reproduction department.

Office Building—The building as now completed is a ten-story and basement reinforced-concrete structure, U-shaped in plan, 300x150 ft., with its main front on the west. The south wing, 75x150 ft. in plan, was

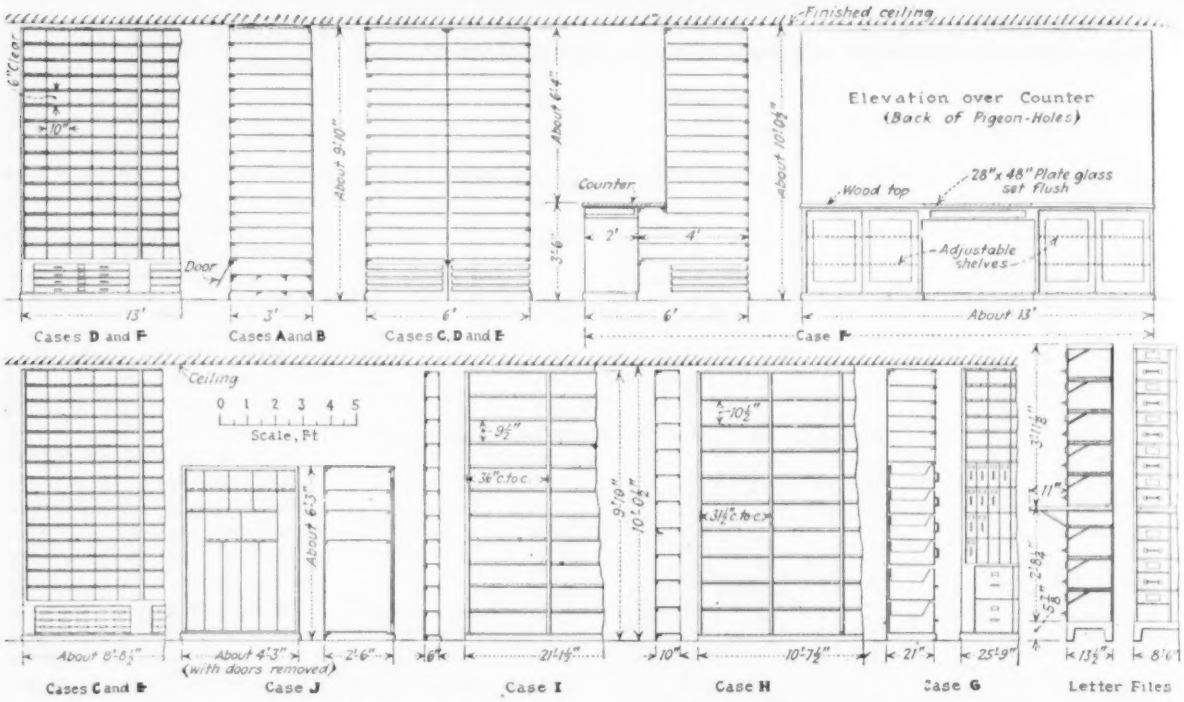

FIG. 5—FILING CASES OF ENGINEERING DEPARTMENT

constructed in 1910 as an annex to an old office building; the latter was pulled down in 1923 to make room for the new addition, completing the structure in its present form. The exterior walls on the north and west, or on the street frontage, are of tooled stone for the first two stories. Above this is terra cotta. The court is finished in white enamel brick and the ends of the wings with kittaning brick.

All of the windows except those on the west front, which faces the grounds of the Kansas State Capitol, have metal sash. The basement has a height of 12 ft. 8 in.; first floor, 11 ft. 9 in.; second floor, 12 ft. 11 in., and third floor, 14 ft. 6 in.; all other floors are 12 ft 3. in. high. The building is heated by steam, the temperature of the rooms being regulated by thermostats. For service in cold weather, when windows cannot be opened, there is a ventilating system which provides fresh air distributed through ducts by forced draft, the foul air being drawn off by exhaust fans. A convenience which is especially appreciated during the summer is the provision of numerous drinking fountains, supplied with practically ice cold water which is kept in circulation by a refrigerating plant.

This office building was designed by E. A. Harrison, architect of the Santa Fé Ry., under the general supervision of C. F. W. Felt, chief engineer of the Atchison, Topeka & Santa Fé Ry. System. Its construction was carried out under the supervision of H. W. Wagner, chief engineer of eastern lines, Santa Fé Ry. The Swenson Construction Co., Kansas City, Mo., was the general contractor.

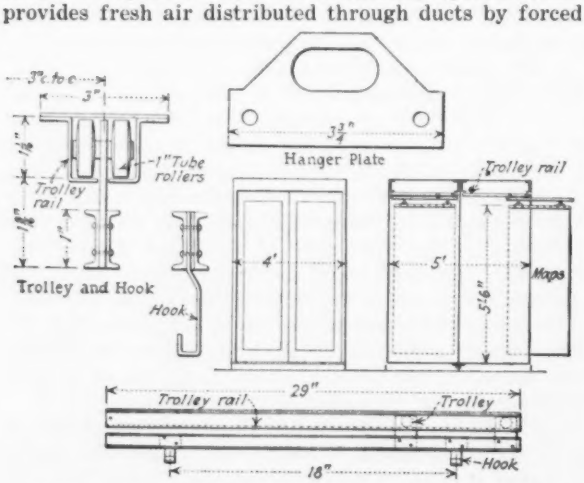

FIG. 6—VERTICAL FILING FOR VALUATION MAPS

Center-Rail Incline in New Zealand

On the Rimutaka Incline of the New Zealand Government Rys., with a grade of 6.6 per cent for three miles, combined with curves of 500 ft. radius, the trains are operated by special locomotives equipped for the Fell center-rail or grip-rail system. In the middle of the track is a double-head rail laid flat, with its web resting on chairs which support it at a height of several inches above the track rails. In addition to the usual wheels and driving mechanism the locomotive has two pair of horizontal driving wheels, operated independently and having axle boxes sliding in guides, so that with a toggle apparatus operated by steam cylinders the wheels can be drawn together to engage and grip the central rails. The scheduled train load is 65 tons and no train is allowed to exceed 250 tons. On the long grade the speed is limited to about 5 m.p.h. The Fell system was first introduced for overcoming the heavy grades of the old Mont Cenis Ry., built across the Alps before the driving of the Mt. Cenis tunnel.

180-Ft. Dam Formed by Landslide in Gros Ventre Canyon

Mass of Loose Rock and Earth Blocks Channel of River — Water Now Running Through Dam

By Frank B. Emerson
Wyoming State Engineer, Cheyenne, Wyo.

A landslide of very unusual size occurred in the valley of the Gros Ventre River, a tributary of the Snake River in northwestern Wyoming, on June 23, 1925. It was described briefly in our issue of July 16, 1925, p. 116, but at the time accurate details as to the extent of the slide and the size of the dam formed across the Gros Ventre Canyon were lacking. Recently Mr. Emerson, in company with O. E. Williams, a local land surveyor, visited the site and obtained the data from which this article has been prepared.—Editor.

Gros Ventre River is an important tributary of the Snake River, joining the latter at a point about 20 miles below Jackson Lake and some forty miles south of Yellowstone Park, Wyoming. For a distance of about 10 miles between the small settlement of Kelly, Wyo., and its source, the Gros Ventre flows through an open country. Above Kelly the stream is located for many miles in a mountainous area flanked upon the south by Sheep Mountain rising to an elevation of several thousand feet. The topographical situation is shown upon the Grand Teton Quadrangle map of the U. S. Geological Survey.

The landslide under consideration occurred on the south side of the Gros Ventre River and at the extreme north end of the main ridge forming Sheep Mountain. The stream level at the point where the slide occurred, about 3½ miles east of what is shown as Nelson's Ranch (now called Kelly), is about 6,800 ft. above sea level. The top of the slide area at a point about 1½ miles from the stream is about at El. 9,000 ft. The vertical distance over which the slide occurred was therefore about 2,200 ft. in the horizontal distance of about 8,000 ft. from the stream. A great wedge-shaped portion of the mountain, starting at the very top of the steep slope leading to the ridge, suddenly left its position and slid across the river late in the afternoon of June 23, 1925. The action, as described by eyewitnesses, was similar to that of a wave of water, the entire mountain side rushing with great speed down and across the valley and dashing against the red bluffs on the north side, then partially settling back to form a solid dam across the stream.

The occurrence is graphically described by "Guil" Huff, the owner of the ranch property just above the dam, and an eyewitness at too near a point, at the time, for his own comfort. Mr. Huff gave the writer the following synopsis of the day's occurrence: "During the morning I was plowing in my field about ½ mile above the center of the slide area. I noted cracks at the base of the hill and several cavings along the hill, some as large as a small house. Seepage was also showing along the base of the hill and the sloughing and seepage continued to occur along a section of about a half mile. At two o'clock in the afternoon the disturbance was continuing and I observed some movement a considerable distance up the mountain. About four o'clock I rode horseback down to the slide looking for cattle and, attracted by the movement of the hill, was interested in seeing what was taking place. All of a sudden a cut bank about 30 or 40 ft. high at the south side of the river started to roll into the stream; then with a rush and a roar came the entire side of the mountain, spreading out in a fan shape and rolling forward with great speed. I turned my horse and rode with all possible speed up the river, needing to change my course twice in order to keep away from the on-rushing mass of rock, trees and earth. It reminded me of a flood of water and only the good horse upon which I was mounted prevented me from being buried. The whole thing was over in about a minute and a half."

William Card, the owner of another ranch partly covered by water, also was an eyewitness, although taking in the sight at a point of more advantage in certain ways. Mr. Card estimated that the whole movement took between four and five minutes. Whether the estimate of Mr. Huff be accepted, or that of Mr. Card, it is evident that the movement occurred with great speed.

FIG. 1—DOWNSTREAM SIDE OF DAM
Water flowing through the mass of rock and earth shows about half way up the slope. Landslide came from the right.

As the dam across the river stands today, it has what may be considered as a top width of about 1,000 ft. The lower face drops off at a comparatively steep slope for a distance of 60 ft. in elevation and then spreads out with a flat slope for a distance of practically ½ mile down the stream. The upper slope of the dam, now under water, is practically a mile in length. The total base of the dam along the river bed may therefore be taken as over 1½ miles. The length of the fill across the valley bottom is approximately ½ mile. The top of the dam most of the way across the valley is remarkably uniform, although upon the north side a large portion was shoved by the original impact a distance of nearly 100 ft. above the main body of the dam. Part of this portion remains resting against the red bluffs and other parts have dropped back as would a wave of water.

The flow of the Gros Ventre River during latter June and July is normally about 1,600 sec.-ft. The dam, rising to a height of approximately 180 ft. above stream level, has created a lake something over 4 miles in length and averaging about 2,000 ft. in width. This lake is estimated to impound about 65,000 acre-ft. of water. The material contained in the slide consists largely of sandstone, limestone, and shale, the rock

varying in size from boulders to masses as large as a house. Intermingled with the stone are trees and other vegetation and what is estimated to be 25 or 30 per cent of decomposed material. The result of the slide was to shut off entirely the flow of the Gros Ventre River for about 12 days. Seepage then began to appear upon the lower face of the dam and this continued to increase as the water rose in the lake formed behind the dam. On July 14 a large increase in the flow was observed and practically the normal flow of the river was soon passing through the dam at a point near the center and about 30 ft. below the top (see water showing white near center of Fig. 1). The writer visited the site July 16 and then found water standing in the lake at an elevation within 5 ft. of the top of the fill. Water has never overtopped the dam, but rather has been lowering in elevation gradually by reason of the increased passageways formed by the water through the coarse material of which the fill is composed. The effect of the slide is the formation of a permanent lake with surface elevation that will eventually be between 15 and 25 ft. below the top of the fill. The flow of the river will probably continue to pass through the fill and work out for itself a rapids leading to the old natural bed of the stream ½ mile below. It is believed that the lake formed will be of no practical benefit as a reservoir as it would be impracticable to construct the necessary outlets for control.

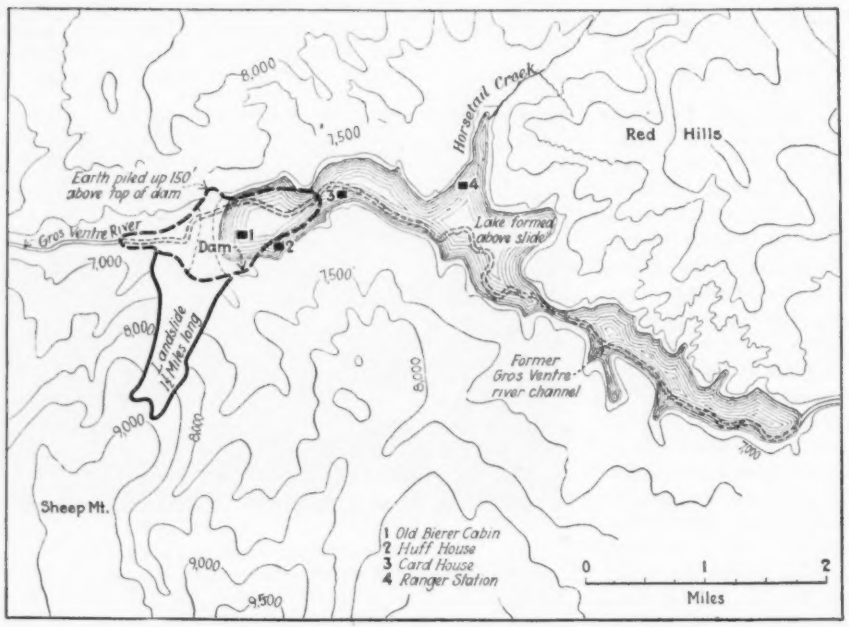

FIG. 2—LOCATION OF LANDSLIDE AND LAKE FORMED BY IT
Sketch from U. S. G. S. maps of Wyoming.

Cause of Slide—The slide may have occurred from one of two causes, or possibly a combination of the two. Some parties living in the vicinity of the occurrence declared that they felt an earthquake tremor preceding the movement of the millions of tons of earth, rock and débris. It is an assured fact that a definite earthquake was felt in the entire region to the north of the slide upon the afternoon of June 25, two days after the slide, and this fact adds some support to the opinion of those who believe that the movement may have occurred as a result of an earthquake. The other cause may be that, due to greater snowfall than usual and more than normal rainfall during the spring season the extra amount of moisture saturated the area included by the slide and caused the slipping of the overburden along the face of the limestones and shale that are now exposed. Slides of minor consequence from such causes are quite frequent in this section of the country, and trouble of this nature is often encountered in the construction of canals and irrigation works. The great amount of material involved makes the occurrence of this slide outstanding. So far as information can be obtained, reports of other slides on the Gros Ventre are unfounded.

For a period of about three weeks following June 23 water supply for the irrigation of about 10,000 acres of land, receiving water from the Gros Ventre, was shut off by the slide. Rains during this period prevented material loss to crops. The real damage caused by the slide consists of the inundation of one ranch, parts of two other ranches and of the ranger station. A section of the road leading up the river was also submerged. In addition, six head of the cattle were caught under the mass of earth and rock. The total loss as a result of the slide would probably not exceed $25,000.

Exaggerated stories of danger from landslides in the Jackson Hole region have been current as a result of the Gros Ventre slide, although there is no substantial basis in fact. This slide is only a spot upon the landscape of the great Jackson Hole country. While a mountain road going up the Gros Ventre River has been put out of commission by the occurrence, none of the main highways into the country have been in any way affected. The advertising the matter has received, however, has caused a marked effect upon the number of people entering Yellowstone Park at the southern entrance, although no element of real danger has ever been connected with the slide, except as to the one man who happened to be in the exact vicinity and was led, largely by his curiosity, to a point of danger. It might be said that a person would probably be safer in any traveled portion of the Jackson Hole region than on some city streets.

A recent development of interest in connection with the slide is the proposal of R. L. Huntley, chief engineer of the Union Pacific R.R. System, that a joint inspection be made by engineer representatives of the railroad company, the states of Wyoming and Idaho, and any others interested in co-operating, to determine whether there is any possibility of a sudden failure of the natural dam thrown across the river as a result of the landslide. The writer's conclusion, as expressed above, is that there is little danger of such a failure, but he will be glad to participate in a closer study of the conditions surrounding the dam than was possible in the recent visit.

N. E. W. W. A. Features Water Treatment and Quality

Abstracts of Papers and Discussions before Convention of New England Water Works Association Held Aboard S. S. Richelieu Last Week

Besides papers on phenol tastes, iodine and goiter, filter design, and scoring water supplies, one dealt with assessments for meeting the cost of water main extensions at Hartford, one with incrustation and carrying capacity of the 350-mile Coolgardie pipe line, and others were descriptive of water-works plants and filters. The papers and discussions are abstracted and summarized below. A report of the excursion and the business proceedings of the convention is given on page 484.—EDITOR.

Phenol Tastes in the Water Supply of Marquette, Mich.

BY PAUL HANSEN
Of Pearse, Greeley & Hansen, Sanitary Engineers, Chicago

MARQUETTE, Mich., has had an unusually long and trying experience with disagreeable tastes and odors in its water supply, due to so-called phenol wastes from the charcoal by-products plant of the Cleveland Cliffs Iron Works, established about 1901. A new water intake put in use in 1901 was of steel, extending 800 ft. into Marquette Bay, Lake Superior.

Early Studies—Investigations of tastes and odors were made in 1904 by Prof. George C. Koenig, of the College of Mines at Houghton, Mich., who ascribed the trouble to "tarry substances, principally floating tar," from the iron works. At that time more tar was being discharged into the lake than now, besides all of the lime-acetate liquors from the iron works. Professor Koenig concluded that floating globules of tar carried by the wind caused the tastes and odors, and proposed that the waste liquors be treated with fine charcoal and then be filtered through fine sand or cinders, and that the tarry matter thus removed be burned under the boilers of the plant. A filter with an area of 500 sq.ft. was built, but there are no data on its design or operation except that it proved to be inadequate. Shortly after this George H. Benzenberg was called in. He attributed the trouble to creosotes in solution and to suspended tarry matters, thought the latter could be filtered out but that dilution with pure water was the only remedy for the matter in solution. To avoid both sewage pollution and the creosote wastes Mr. Benzenberg advised a 2,100-ft. extension of the intake to a water depth of 55 or 60 ft. In 1906, Clarence Coleman, an engineer engaged to report on the protection of a boulevard against storm action, seconded Mr. Benzenberg's recommendation. Following this, Dr. McCracken, a professor of chemistry at the Marquette State Normal School, subjected samples of lake water to a "color test" recommended by the "chemist in charge of the laboratory at Ann Arbor."

Intake Extension—In 1909, Rudolph Hering was engaged to give a day to the water problem. He concluded that an intake in 70 ft. of water would probably give satisfactory water for a considerable period. In 1910, the Duluth Engineering Co. estimated that the intake could be extended to 70 ft. of water for $48,000, and that an inlet at Presque Isle, discussed in some of the other reports, would cost $248,000, with uncertainty as to its success. A majority of the local fire and water board favored the $48,000 project. In 1910, George A. Johnson, then of Hering & Fuller, advised that the intake be extended to 70 ft. of water. Work was started that year and in 1912 the intake was extended 2,300 ft. From 1912 to 1920 the water gave comparatively little trouble. Late in 1920, the city determined on further attempts to get rid of tastes and odors. In the next February, E. D. Rich, state sanitary engineer, was asked to visit Marquette. He concluded that chlorine treatment of the water intensified the trouble; that some of the taste might be removed by filtration through coke or cinders, at the rate of 30,000 gal. a day; that chemical treatment would not do; that discharging "the wastes into the city sewers might through biological action break up the taste-producing compounds," as was observed at the "Milwaukee sewage-testing station; and he also suggested the possibility of pumping the wastes to a lake outlet beyond Presque Isle, where they could not reach the intake. Next, the U. S. Public Health Service detailed H. B. Hommon, associate sanitary engineer, to study the problem, and he was joined by W. C. Brockway, assistant engineer, Michigan Department of Health. They concluded that the tastes were caused by tarry residue from the evaporation of crude pyroligneous acid and the residue from a crude wood alcohol still, and suggested that if these residues could not be evaporated then research would be needed to find some other method of treatment.

Latest Report and Plan—A shutdown of the iron works from February, 1921, to March, 1922, during which time there was no trouble from wastes, postponed further action. Soon after re-opening the plant, although some of the wastes were then being evaporated, tastes recurred. The city authorities took no further action until early in 1924, when they engaged Pearse, Greeley & Hansen to study the problem. These engineers obtained the co-operation of Dr. A. M. Buswell, on the chemical side. After extended investigation the experts advised that the pyroligneous acid and the wood alcohol wastes be given a partial treatment at the iron works; then be discharged with the city sewage into a reaction tank (designed for possible conversion into an activated-sludge plant), with a retention period of about eight hours; and that finally the combined wastes and sewage be discharged at a point that would require a change in direction of flow before reaching the water-works intake. There is about 1 volume of wastes to 15 volumes of sewage. [No funds for the execution of this plan have yet been appropriated, according to Mr. Hansen.—EDITOR.]

* * *

System of Sanitary Grading of Water Supplies

BY E. SHERMAN CHASE
Sanitary Engineer, Metcalf & Eddy, Consulting Engineers, Boston, Mass.

THE SCORE system presented in this paper is in the main a modification of the system used in the New York State Health Department as developed by the author and Theodore Horton, formerly chief engineer of that Department (see annual report for 1915). The system herewith presented modifies and expands the original system in several respects. Water supplies are divided into two main classes, surface and ground. The surface supply group contains a special sub-group consisting of supplies taken from the Great Lakes system and from the Mississippi and St. Lawrence Rivers. The ground-water supply group also contains a sub-group consisting of supplies taken from wells over 500 ft. deep.

In dealing with water supplies from the sanitary standpoint, there are three major factors to be considered: (1) Pollution hazards; (2) protective measures; (3) quality condition. Pollution hazards include conditions active or potential which bring about or tend to bring about pollution of the water supply, such as resident population on the watershed or the direct discharge of sewage into sources of supply. Protective measures consist of those barriers, either natural or artificial, which prevent or tend to prevent pollution in the original source of supply reaching the consumer. Natural storage and filtration are examples of protective measures. Quality condition is determined by the results of analyses and by those physical attributes perceptible to the senses. Of these, bacterial content and taste and odor are examples.

The score system here presented is based on a range of values from 0 to 100; the higher the score the better the sanitary condition of the supply. The 100 scale is divided

into three parts of 50, 20 and 30, which are assigned to the factors for pollution hazards, protective measures and quality condition, respectively. These values are assigned when the factor under consideration represents perfect or nearly perfect conditions. The sum of perfect scores for the first and third factors alone, does not equal 100. This is due to the fact that under conditions as they exist no supply in the absence of barriers against chance pollution can be considered perfect.

Prior to the publication of this paper [in *Journal*, N.E.W.W.A.—EDITOR] it is planned to supplement it by the preparation of scores for a number of water supplies for which the necessary data are comparatively complete. It is believed that if water-works officials would balance the sanitary liabilities and assets of the water supplies in their charge according to this or a similar score system, they would discover unexpected and unappreciated hazards. With progressive water-works men a defect exposed is a defect remedied.

Discussion—B. C. Little wondered if two persons would get the same scoring results. Charles W. Sherman, who in the absence of Mr. Chase had read the paper under discussion, replied that there might be variations in items, which would probably even up in the totals. M. N. Baker, New York City, thought that scoring under this plan might well be made by engineering divisions of state health departments, and that comparisons of the scoring results with the vital statistics of the corresponding cities might throw light on the applicability of the scoring method. A motion calling for the appointment of a committee to consider the whole subject was carried.

* * *

Iodine and Water Supplies

BY H. W. CLARK
Chief Chemist, Massachusetts Department of Public Health, Boston, Mass.

DURING the past year and a half we have determined the iodine content of about 80 Massachusetts water supplies. The average amount of iodine in the supplies examined is 2.14 parts per billion and we have found it present in as great an amount as 6.3 parts per billion. It has been absent from one or two supplies and the amount in our surface waters averages greater than in our ground waters. As a few of our waters contain little or no iodine and others contain comparatively large amounts, studies of the prevalence or non-prevalence of goiter in the state are being made by the State Department of Public Health to determine whether or not we have any particularly goiterous regions, and if the municipalities, the water supplies of which are low in iodine, are more markedly goiterous than those municipalities the supplies of which contain much greater amounts of iodine. We believe that our goiter rate is low but will know more concerning it when this study has ended.

Application of iodine to water supplies showing a lack of this element appears to be more or less wasteful, although it may be found eventually to be the most feasible way in certain instances. The ideal way of overcoming the iodine deficiency is the use of iodized salt for table use and for use in the preparation of food, and a greater consumption of sea food. When we were dependent on evaporated sea water for all our salt we probably had iodine served to us in the most simple, economical and efficient way, and it is easy to add to the salt from our salt mines the same amount of iodine as found in sea salt. Other elements in this salt from evaporated sea water may have and probably have enhanced our health and well being.

* * *

Some Features of Filter Design

BY JAMES W. ARMSTRONG
Filtration Engineer, Baltimore, Md.

FOR such cities as receive their water from small streams, the purification process may be greatly simplified and cheapened by the control of the watershed. This is especially the case with streams flowing through hilly country over clay or easily eroded soils. If the shore line for a considerable distance from the water's edge can be kept in grass or planted in trees or shrubs to prevent erosion, the sudden increases in turbidity so troublesome to filter plant operators may be greatly reduced. If in addition an impounding reservoir of sufficient size can be created, the water delivered to the purification plant may have many of its characteristics changed for the better, as the experience with the Loch Raven Reservoir [Baltimore] shows. The shore line of this reservoir, due to its very irregular shape, extends for about 50 miles and is absolutely controlled by the city. The following are some of the benefits resulting from the creation of this reservoir: A great reduction of the number of bacteria in the raw water, especially those of the colon variety. The 20-deg. counts used to vary from several hundred to 800,000 per c.c., whereas now they never exceed 13,000 per c.c. The turbidity, which used to vary from 10 to 5,000, was reduced to an average of about 15 and has never exceeded 200. As a result of this change, the city has saved thousands of dollars worth of chemicals each year since the dam was raised. Another gain has been in the coolness of the water during the summer. The maximum temperature of the water reaching the plant is now about 65 deg. F., which is 6 deg. lower than the average of previous years. There has also been a saving in the matter of cleaning the coagulating basins. Once a year now suffices, whereas in the past it was necessary to clean them two or three times a year.

Mixing Basins—Laboratory experiments indicate that, in order to secure the best results, the water should be violently agitated immediately on application of the coagulant; afterward, the agitation may be reduced and excellent results obtained; but if the process is reversed and the coagulant be applied to water that is moving very slowly and with little agitation and is afterwards agitated, no matter how violently, poor or very indifferent results follow. It is possible that mixing basins of the future will combine mechanical agitation with the baffled type of basin in general use today. In small plants, where it is difficult to secure funds for construction, mechanical agitation might be cheaply and satisfactorily used.

Perhaps the commonest type of mixing basin is that with an around-the-end type of baffle. The advantage of such a type is that a natural hydraulic gradient is maintained throughout the plant for all possible rates of flow, with just sufficient loss of head to overcome the necessary frictional resistance of the channels. This means a minimum pumping lift at all times, and a proper carrying velocity can be maintained to secure the suspension of the floc. Should the velocity be too slow, sediment will be deposited until a carrying velocity is secured, and if the velocity is increased, scouring action will take place until the required area of channel has been reached. Experiments made at the Baltimore plant under regular plant operation with mixing basins of this type having thirteen 180-deg. turns, show that there is a distinct gain in the subsiding value of the water at each succeeding turn.

Pipe Galleries—The most objectionable point of some filter plants is the pipe gallery. A crowding of pipes and valves into a narrow space makes the place very inaccessible and consequently a place that is neglected by the employees. In the new plant now under construction for Baltimore a happy combination of circumstances has resulted in pipe gallery freer from obstruction than any other I have yet seen. Concrete conduits and compartments have in most cases replaced special castings. The controllers are in a pit connecting two concrete compartments, one opening into the filters and the other into the filter effluent conduit.

Concrete—In the earlier days of filter-plant construction, reinforced concrete seemed to meet all structural needs of the designer, but after a few years of service it was noticed that certain sections of concrete, particularly in the colder climates, began to disintegrate. While the cause of the deterioration of concrete is not altogether known, it seems there are two very important factors that have not been sufficiently considered, one of which is the quality of sand, and the other the matter of imperviousness. The disintegration of concrete can sometimes be accounted for by the use of local sand containing impurities of an organic nature that are entirely overlooked. A slight seepage of water through concrete walls has often been regarded as of little significance, but recent careful observations seem to point to the fact that any concrete structure through which water

is seeping is doomed and will ultimately fail altogether. This is particularly true in places subjected to frost action.

There is a combined chemical and mechanical action continuously at war against water-bearing concrete. The calcium compounds are soluble in the presence of most waters. Even calcium carbonate is soluble in waters whose pH value is below the solubility equilibrium. Any water whose pH value is less than 7.5 and alkalinity less than 100 will dissolve calcium carbonate. In the presence of waters of low pH value, such as are found in many places in New England, the calcium compounds in the concrete are gradually dissolved and the evidence of such action is indicated by white efflorescents or deposits on the surface of the concrete. When concrete is submerged, the same dissolving action takes place, but there is no visible evidence of it unless the surface begins to flake off. Not only is the calcium attacked but the aluminum compounds are slowly and gradually dissolved. The leaching out of these chemical compounds robs the concrete of its strength and makes it very susceptible to the disintegrating action of frost. The rapidity with which the destructive work is accomplished depends very largely on the porosity of the concrete.

When the first Baltimore filter plant was built, all the concrete was apparently excellent, but after a few winters it was noticed that in some of the walls, concrete began to chip off at the joints where frost action could exert pressure against two adjacent surfaces. Each succeeding winter the spalling off of the concrete became greater, until at the present time some of the baffle walls near the water surface have become completely disintegrated, while others are apparently in good condition. We believe the trouble is due to one of two causes: either to impure sand, or to the fact that the injured walls were not as impervious as the others.

Filter Bottoms—It is believed that the slat-bottom filters, of which there have been some written accounts recently, are the most economical yet devised. I am thoroughly convinced that there is no value whatever in the so-called strainer system with restricted orifices or strainers for the water to pass through. The only value of a restriction is to insure a proper distribution of wash-water through the channels or pipe manifold.

Filter Sand—If an optimum size of filter sand can once be determined, it should be nearly the same size from top to bottom as it is possible to secure. To obtain the best results each water should receive special study and even then it may not be possible to select a size of sand that will be entirely satisfactory.

Discussion—Speaking on that part of the paper relating to concrete, Edward G. Bradbury, Columbus, Ohio, stated that a wet concrete is likely to become porous, and Morris Knowles, Pittsburgh, Pa., said that sand and gravel from streams heavily laden with sewage like those at Pittsburgh, is likely to be covered with a colloidal film which may cause porosity in concrete.

* * *

Financing Main Pipe Extensions by Assessment Method

By Caleb Mills Saville
Manager and Chief Engineer Water-Works, Hartford, Conn.

WHERE there is no income reserve or depreciation fund for financing water main extensions, as is generally true of municipally-owned works, resort is commonly had to either assessments of the cost of the main on abutting property or to guarantees from consumers of sufficient revenue to meet the annual charges caused by the extension. One of the drawbacks to the guarantee plan is that once a main is laid non-guarantors have certain rights to water, which is unjust to the guarantors. For several years Hartford, Conn., has financed extensions by assessments, after a filing of petitions, advertised hearings, etc. For corner lots, there is an exemption of 75 ft. on one frontage —which is sometimes unjust with acute angles. The assessment is at a maximum rate of $1.75 per front foot (assuming a 6-in. main, although so small a one is seldom used), with 75-ft. exemption for one of the frontages of corner lots—which works an injustice where the front lines form an acute angle. At present, costs are taken as the average of the cost for the past five years, with an overhead of 15 per cent for labor and 10 per cent for material. Yearly bond issues of $100,000 are floated to provide immediate funds, and from income $10,000 a year is being paid into a revolving fund to be brought up to $150,000. Street intersections costs are met by the city.

Discussion—Edward G. Bradbury, Columbus, Ohio, sanitary engineer of Franklin County, outlined a plan adopted for district water and sewer systems in that county and since adopted in other counties, under which the entire first cost of the improvements is assessed on the real estate in the district. The assessments are not made until the work is done and then include bond interest during construction and a percentage for clerical and engineering work. The measure of benefit is based on the enhanced value of each piece of property, but assessments are so distributed that they will eventually bear at the same rate per acre, after corrections for variations in value. A time factor is allowed to cover lands that will not have water or sewer service for some years to come and other possible variations in benefit taken into account. The courts have ruled, Mr. Bradbury stated, that benefits based on property valuations are legal if the assessors decide after due consideration that the plan as applied is in accordance with benefits conferred. Morris Knowles stated that benefit assessments are not legally permissible in some states; steps to make such assessments legally possible for a wide range of public improvements have been taken in Pennsylvania.

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Other Papers and Discussions

PAPERS chiefly descriptive in character, some ranging over a long period of years, were submitted as follows: The first slow sand filters at Lawrence, Mass., their subsequent operation and improvement, and the new sand filters recently put under way were dealt with by Morris Knowles and Myron G. Mansfield, consulting engineers, Pittsburgh, Pa., and Patrick Nugent, superintendent of the Lawrence water-works. The gravity water supply of the City of Quebec was described by J. A. Tremblay, chief engineer water-works department, and the old pre-filters and slow sand filters at Montreal and the projected 120-U.S. m.g.d. standard-type mechanical filters were described by Frederick E. Field, filtration engineer, Montreal Water Board. Mr. Tremblay said that of the three cast-iron supply mains at Quebec the first one, laid in 1853, was of the best material, and that its carrying capacity has been diminished only some 25 per cent by incrustation. All the supply mains are carried across an open iron bridge, about 150 ft. long, without protection against freezing. The velocities range from 1.5 or 2 to 3 ft. per second. The new water-supply and filtration works of Wheeling, W. Va., were described by J. F. Laboon, of the J. N. Chester Engineers, Pittsburgh, The heavy water consumption (400 gal. per capita per day) at Wheeling was greatly reduced in a short time by metering industrial services, so that the total consumption fell materially notwithstanding the addition of 3,000 services.

A lengthy paper on the 350-mile Coolgardie pipe line, Western Australia, and means taken to prevent corrosion, was contributed by Col. F. F. Longley, of the Lock Joint Pipe Co. The paper was a critical study of data presented in 1915 and earlier before the Institution of Civil Engineers, supplemented by later information. It dealt largely with reductions in the carrying capacity of the conduit due to corrosion, and the somewhat problematic effect upon delivery of the de-aeration of the water by lime treatment. In a written discussion of the paper F. N. Speller, metallurgical engineer in charge of research, of the National Tube Works, Pittsburgh, Pa., urged that steel pipe be kept out of corrosive soils and that tar coatings be avoided. The Coolgardie engineers deserve credit for being pioneers in large-scale de-aeration of cold water, but probably it would have been better if the process had been adopted when the pipe line was first put in use.

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[A paper on the "Fineness Modulus for Filter Sands," by Prof. R. G. Tyler, and portions of Mr. Armstrong's paper on "Filter Design" dealing with apparatus used in water testing will be abstracted in later issues.—Editor.]

Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our Representative Small Cities

Eugene, Ore.

SKINNER'S BUTTE, EUGENE, ORE.

EUGENE, LANE CO., ORE., is chiefly a manufacturing city and a center for a rich fruit raising district but it is also a "college town" by virtue of being the location of the state university which has an enrollment of 2,000 to 2,500 students. The Willamette River borders the city on the north and serves a dual function in that it brings the city's water supply and carries away its sewage. The municipal electric power system, offering low rates, has been successful in attracting industries; the list now includes, among others, a woolen mill, lumbering and planing mills, chemical works, flour mill, ice and cold storage plants, creameries, repair shops of the Southern Pacific R.R. and factories for the manufacture of excelsior, boxes, mattresses, incubators, cedar chests, wheelbarrows and bottles. The wholesale houses of Eugene make the city an important distributing center for western Oregon. Pop. 18,500.

IN THE pioneer days of the west when trains of covered wagons were moving over the Oregon Trail, Eugene Skinner took up a donation land claim on the Willamette River, 122 miles south of Portland and 60 miles from the Pacific Coast. That was in 1858, before there was much travel up the Willamette, but Skinner's place soon became known as a stopping point and a typical frontier settlement sprang up there. It is still a settlement typical of western Oregon, although now a decidedly modern city with only its name and Skinner's Butte, a picturesque knoll at the north end of the main street, to commemorate the founder. The fact that the city was incorporated in 1864, seven years before the railroad was built, is a further indication that its history has had to do with sturdy pioneer stock.

Harry E. Devereaux has been city engineer of Eugene for the last ten years, in which time the city has more than doubled in population with all the incidental engineering requirements of a rapidly growing city. His staff numbers about 24 men including field parties and inspectors during the May-to-December construction season. Under the Eugene charter the city engineer reports direct to a council of eight men, two from each of the four wards. The council is subdivided into eight committees of three members each, of which the city engineer has to do primarily with streets and sewers. The street department deserves special attention not so much because of the large amount of work done as because Mr. Devereaux is recognized in the Northwest as a pioneer in paving matters; he has built up a very favorable reputation by his thorough study of the fine points involved in laying good pavement.

Paving—In the early days much sheet asphalt (usually 2 in. thick on 4 in. of gravel) was laid in Eugene, but maintenance on this class of surfacing was very heavy despite the most painstaking attention to materials and methods in an endeavor to get the best possible results. Perhaps this is at least partly due to ground and moisture conditions and the consequent difficulty of keeping foundations firm enough to afford the support necessary for asphalt. On streets of slight grade the asphalt has corrugated, pitted or broken up extensively under traffic and there is also complaint of a tendency to slough and flow on the hills in summer (Eugene has one block of concrete pavement on College Hill on a 16½ per cent grade).

No final decision has been made to use concrete exclusively and bids on both asphalt and concrete are still called for in some districts. "Personally," says Mr. Devereaux, "I think a black pavement on a concrete base is a very satisfactory pavement." However, it happens that Eugene has laid nothing but concrete since 1919 and during the first seven months of 1925 the amount laid totaled 175,000 sq.yd. Costs to property owners this year for concrete pavement, 6 to 7 in. thick, have been $4.90 to $5.80 per front foot where the width between curbs is 34 ft. The only reinforcing used is in the form of tie rods across the longitudinal joint on the center line.

Specifications on finished concrete surfaces are very rigid, and as all pavement construction is contracted very close inspection has become the invariable rule. For example, it is required that, before floating, the surface shall be tested by a straight-edge and any irregularities exceeding ¼ in. in 10 ft. eliminated. When the pavement is hard enough to walk on another check is made by the inspector and any deviations from this 1-to-480 irregularity ratio are marked for removal by carborundum brick and water. A penalty of 10 per cent of the cost of the slab is charged against the contractor for irregularities that cannot be eliminated without cutting into the coarse aggregate.

By insisting on exact proportions, mixing and construction generally, a good grade of concrete has been secured which gives what is believed to be an absolute minimum of maintenance even under the heaviest traffic. How Eugene has pioneered in this respect is shown by the fact that as long ago as 1919 and 1920 samples taken from the pavement showed an average 28-day strength in compression of 4,100 lb.

Under the earlier design diagonal cracking occurred in concrete slabs at intersections where one slab was continued around a corner without contraction joints. This has been remedied by laying out joints at intersections so that no slab is continuous around a corner. Triangular breaks at intersections probably caused by heavy trucks have been prevented by the use of 4x4-ft. x 6-in. slabs of 1:3:6 concrete placed under the intersection of joints between slabs. Five such slabs are used at each intersection.

An attractive feature of Eugene's paving practice is the uniformity of private driveways between curb and sidewalk. The parking strip is usually 7 to 10 ft. wide and until recently driveways across this strip were always put in by the city as part of the paving contract, and were all given the same easy, uniform grade from gutter to sidewalk. The city no longer makes these as part of the main contract but encour-

ages property owners to make individual agreements with contractors when the street paving is done.

"We do more engineering on contract jobs than the average city," Mr. Devereaux says, "in order to get better work." For example, in making surveys for new paving jobs the city sets grade stakes along the curb as well as on the center line. When the subgrade is restaked for concrete forms the city puts in hubs on the curbline 20 ft. apart, driven to exact grade so that the headers can be set directly upon them.

When asphalt was first laid in business streets no concrete gutters were put in. This resulted in deep corrugations along the curb and as fast as possible this asphalt is now being replaced with concrete gutters. Where this work is under way the radius of the curb curve at intersections is being increased which makes a decided improvement in traffic conditions. The standard radius is now 16 ft. An experiment is being made by mixing yellow ochre with the concrete that goes into the curbs where "no parking" regulations are in effect. Heretofore yellow paint had been applied to the curb to mark the forbidden zones at hydrants and near corners and it is maintenance on these paint strips that the colored concrete is expected to eliminate.

Water Supply—The water department in Eugene, entirely separate from the engineering department, is in charge of C. A. McClain, superintendent. Mr. McClain is an engineer and was formerly a professor of engineering at the University of Oregon. His responsibilities are really those of a manager and he reports to a water board of five men instead of to the city council. This board is an honorary body, elected by the city voters, and has final authority in all water department affairs. In addition to the city's water system Mr. McClain also has entire charge of the 4,200-hp. municipal hydro-electric plant and conducts, much as would a small public utility company, a general electric light and power business. He thus employs a considerably larger office and field force than does the city engineering department itself.

The water board is operated, as much as possible, like a private corporation. All city service is metered and billed the same as are private consumers—there is no "free service." On the other hand, the water department pays the engineering department for all paving cuts, etc., and thus the books of the two departments are kept strictly separate.

The city bought the water and the electric systems from private companies some 15 or 16 years ago and has made them both pay. The electric system was a natural adjunct of the water system because of the heavy power requirements attendant upon pumping the water supply, but pumping has come to be only a small part of the service furnished by the electric system which now supplies some 5,000 customers.

The water supply is taken from the Willamette River which borders the city on the north, and is pumped thence into a bank of eight gravity filters draining into a clearwell. The filtered water is repumped directly into the city distribution system, thus eliminating all main supply lines, the largest pipes in the system being the 12-in. mains in the distribution network. Three balancing reservoirs are located on high elevations in the outskirts of the city, but because these are now of insufficient capacity, one is to be rebuilt on a larger scale and still another one is to be added. The new reservoirs will be covered, partly to keep the water cooler, but primarily as an assurance against pollution which is considered a potential danger where there is no flow directly through the reservoir. The two pumps in service are rated at 2 and 3 m.g.d. respectively and a 4-m.g.d. unit is now being added. These pumps keep the pressure in the distribution system at about 80 lb. per sq.in. The maximum demand is 3 to 4 m.g.d., the average for the year being about 110 gal. per capita per day.

Both steel and cast-iron mains are in use and although the extensive improvements being made this year are all in cast iron, no fixed policy has been decided upon as to the exclusive use of either type. The distribution system originally included some wood-stave pipe of 4, 6 and 10-in. diameters. Much of this has been replaced with metal pipe as larger sizes have become necessary or as reconstruction has been undertaken for other reasons, but the wood itself (Douglas fir) is in excellent condition after 16 years in the ground. The steel wire hoops deteriorated in some places close to electric railway lines and this was ascribed to electrolysis even though the winding was spiral. This deterioration was confined to the under side of the pipe; here the banks were eaten through in many places although along other parts of the same wraps there was practically no rust or corrosion.

Tapping into wood-stave lines of all three sizes is done with a Mueller tapping machine, boring into the wood and then screwing into the hole a corporation cock provided with a thread suitable for wood.

A recently approved bond issue of $500,000 provides for a new reservoir and service line as well as a new 30-in. supply line that will substitute for the Willamette water a supply taken from the McKenzie River seven miles east of the city. The Willamette water now requires to be disinfected as well as filtered on account of sewage pollution from other cities upstream. Water from the new source will be delivered by gravity to the present filters and the same pumping plant will handle the filtered water just as is now being done.

Building and Park Departments—The building department in Eugene has no direct contact with the city engineer and the head of this department, the building inspector, reports directly to the city council. The park department, also managed independently of the city engineer's office, has jurisdiction over a municipal auto camp in which the city takes much pride. This park has been very popular and on a charge of 50c. per night per car (including free wood, light and water) has been bringing the city $1,000 per month gross.

This income not only pays the upkeep of the park (which is in fact a park and is even now used extensively by residents as well as by auto tourists) but also pays the upkeep of the city's other parks plus the salary of the park superintendent and his assistant. However, the auto park was not planned as a money-making venture and is an endeavor to interest travelers in the city by helping them to enjoy their stay there. Twenty-five families that settled in Eugene last year stayed first at the municipal auto park. Eugene was the first city in the Pacific Northwest to own its own aviation field. The area devoted to this purpose consists of approximately 100 acres and has been developed into a Class A field.

Apportionment of Street Improvement Costs at Baker, Oregon

By Philo H. Anderson
City Engineer, Baker, Oregon

EXCEPT when otherwise explicitly stated in the initiatory petition, the cost of street improvements in Baker, Ore., is assessed against the abutting property to a depth of one-half the distance through the blocks adjacent to the improvement.

It is obvious that the property adjacent to the street is more directly benefited by the improvement than

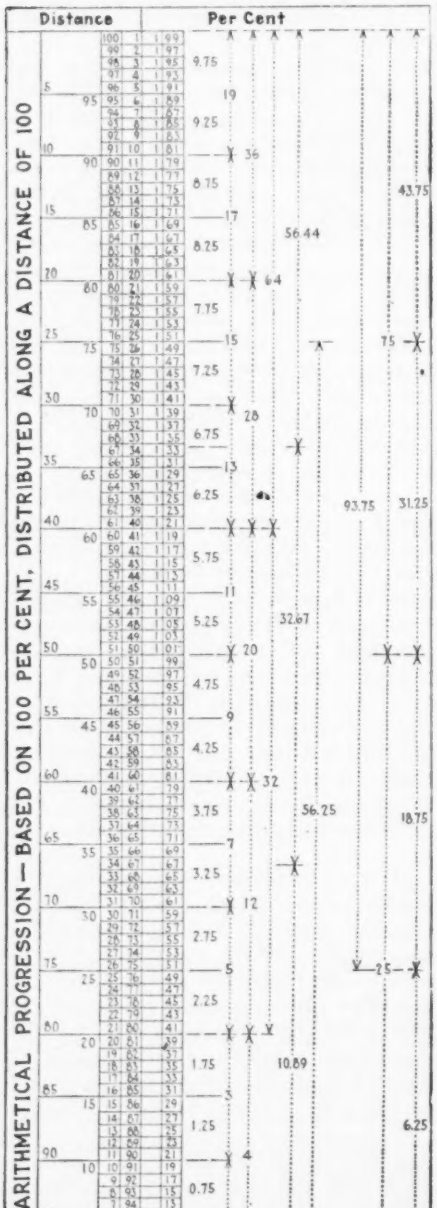

FIG. 1—TABLE USED IN COMPUTING STREET IMPROVEMENT ASSESSMENTS AT BAKER

Based on uniformly decreasing arithmetical progression. Half depth of block, regardless of depth of lot, is taken as 100 and the first 1 per cent of depth is charged at rate of 1.99 per cent and last as 0.01 per cent. Figures between the vertical lines at right are totals of percentages between corresponding witness marks.

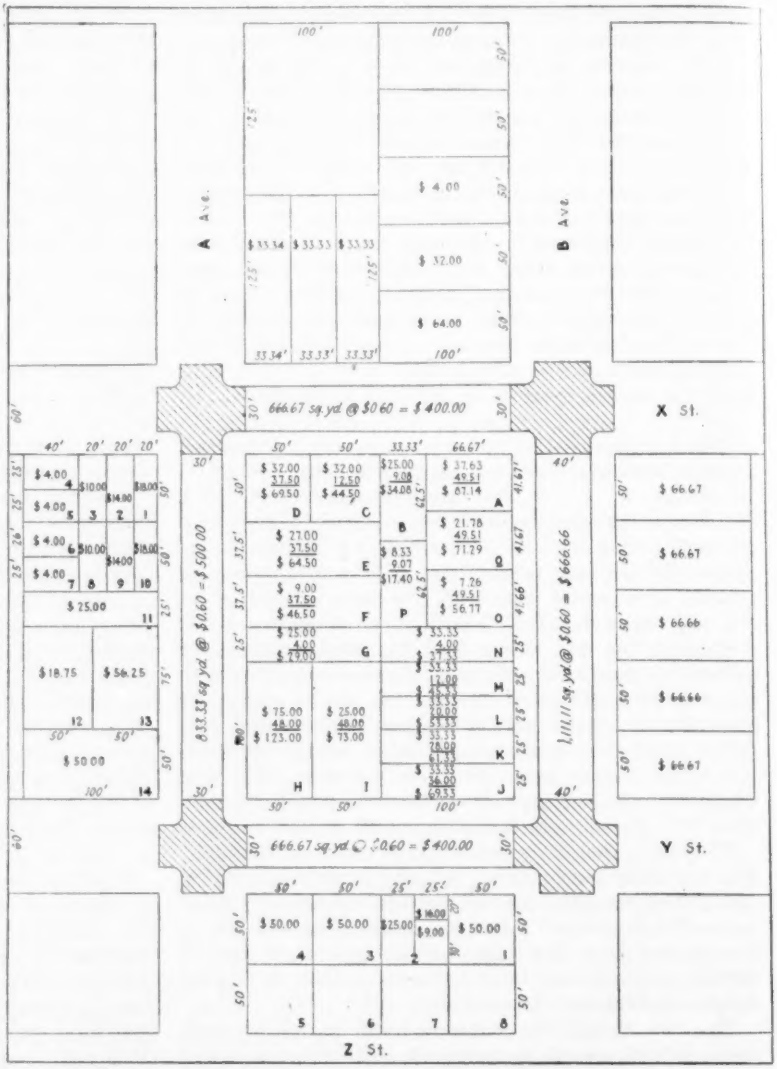

FIG. 2—SCHEME OF STREET IMPROVEMENT ASSESSMENTS AND THEIR COMPUTATION USED AT BAKER, OREGON

Improvement of the crosshatched area at street intersections is paid for by the city from a fund provided for the purpose. The remaining street area is assessed on the abutting property.

Consider the half block north of *X* St. The pavement on *X* St. cost $400, of which the half block under consideration pays $200. The block is 200 ft. long so the cost is $1 per front foot. Three lots reach back to the center of the block and are 33.34 ft., 33.33 ft., and 33.33 ft. wide respectively; hence their assessments are $33.34, $33.33 and $33.33. Three lots parallel *X* St. They occupy 40, 40 and 20 per cent of the distance between *X* St. and the center of the block. The table shows the first 40 per cent pays 64 per cent of the cost, the next 40 per cent pays 32 per cent of the cost and the last 20 per cent pays 4 per cent of the cost. There being $100 to apportion among them, their assessments are $64, $32 and $4 respectively.

Take next the half block south of *X* St. It is 200 ft. long and there is $200 cost, or $1 per property foot. Lots *C*, *D*, *E* and *F* pay $100. Lots *C* and *D* occupy 40 per cent of the distance back to the center of the block. The first 40 per cent of the distance pays 64 per cent of the cost. Lots *C* and *D* pay $32 each. Lot *E* occupies the next 30 per cent of the distance which the table shows should pay 27 per cent of the cost, or $27. Lot *F* occupies the last 30 per cent of the distance. The table shows that lot *F* should pay $9. Lots *A*, *B*, *O*, *P* and *Q* pay $100, apportioned as follows: Lots *A*, *Q* and *O* pay $66.67. Each occupies 33⅓ per cent of the distance between *X* St. and the center of the block. The table shows their cost percentages to be 56.44, 32.67 and 10.89 per cent. 56.44 per cent of $66.67 is $37.63, *A*'s assessment for *X* St., 32.67 per cent of $66.67 is $21.78, *Q*'s assessment for *X* St., 10.89 per cent of $66.67 is $7.26, *O*'s assessment for *X* St. Lots *B* and *P* pay $33.33. *B* occupies 50 per cent of the

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property more remote from the street. In order that all assessments be uniform, relative to their distance from the improvement, their position in blocks of various sizes and shapes and the size and shape of the individual lots, it is necessary to select some method of computation that is applicable to all cases. An arithmetical progression was adopted as the most equitable method of apportionment, and a table (Fig. 1) was constructed which gives the percentage of cost

distance back to the center of the block. The table shows the first 50 per cent should pay 75 per cent of the cost and the last 50 per cent of the distance should pay 25 per cent of the cost. 75 per cent of $33.33 is $25, *B*'s assessment for *X* St. 25 per cent of $33.33 is $8.33, *P*'s assessment for *X* Street.

The half block north of *Y* St. is assessed next. As was the case on *X* St. the cost is $1 per property foot. Lots *G*, *H* and *I* pay $100. *H* and *I* occupy 80 per cent of the distance back to the center of the block and by the table should pay 96 per cent of cost. *H* and *I* pay $48, each on *Y* St. Lot *G* pays $4 on *Y* St. Lots *J*, *K*, *L*, *M* and *N* pay $100. Each lot occupies 20 per cent of the distance to the center of the block. The table shows their assessments should be $36, $28, $20, $12 and $4 respectively for *Y* Street.

The half block south of *Y* St. is a narrow block, the depth to the center of the block being but 50 ft. There are four 50-ft. lots that pay the $200, or $50 per lot. One of these lots is subdivided. The west half of the subdivided lot pays $25. The north 40 per cent of the east half of the subdivided lot pays 64 per cent of $25, or $16. The south 60 per cent pays 36 per cent of $25, or $9.

Inspection shows the cost per property foot on *A* Ave. to be $1 per property foot. Assessing the half block west of *A* Ave. Lots 1 to 5 inclusive pay $50. Lots 1, 2 and 3 each occupy 20 per cent of the distance to the center of the block. Lots 4 and 5 occupy 40 per cent of the distance. Referring to table it is found the assessments in each case as percentages of $50, should be: Lot 1, 36 per cent or $18; lot 2, 28 per cent or $14; lot 3, 20 per cent or $10; lots 4 and 5, half of 16 per cent, or $4 each. In like manner the assessments for lots 6, 7, 8, 9 and 10 are found to be $4, $4, $10, $14 and $18 respectively. Lot 11 pays $25, as it reaches back to the center of the block. Lots 12 and 13 pay $75, apportioned as follows: Lot 12 pays 75 per cent of $75, or $56.25. Lot 12 pays 25 per cent of $75, or $18.75. Lot 14 pays $50 for *A* Ave. improvement.

The assessments are apportioned to the half block East of *A* Ave. as follows: Lot *C*, 25 per cent of $50, or $12.50. Lot *D*, 75 per cent of $50, or $37.50. Lots *E* and *F* are 37.5 ft. wide and reach to the center of the block, hence they pay $37.50 each. Lot *G*, $25. Lot *H*, 75 per cent of $100, or $75. Lot *I*, 25 per cent of $100, or $25.

The half block east of *B* Ave. contains five lots of equal size and they all reach to the center of the block. Each lot pays one-fifth of $333.33, or $66.67.

The half block west of *B* Ave. pays $333.33 and is 250 ft. long. The cost is $1.33⅓ per property front foot. Lots *J*, *K*, *L*, *M* and *N* pay 25 times $1.33⅓ or $33.33 each. Lots *A*, *B*, *O*, *P* and *Q* combined pay $166.68. Their assessments are as follows: Lots *A*, *Q* and *O*, ⅓ of 89.11 per cent of $166.68, or $49.51 each. Lots *B* and *P* half of 10.89 per cent or $9.08.

each per cent of the distance, between the street and the center of the block, would pay. For example, the table shows that the first per cent of the distance should pay 1.99 per cent of the cost and the last per cent of the distance should pay 0.01 per cent of the cost.

To determine the cost of improvement on each street the following method is used: The total number of square yards of streets improved within the district is determined. The total cost, including contract price, engineering, inspection, advertising, incidentals, etc., is ascertained and from this the cost per square yard of the improvement is computed. The number of square yards of improvement in each street is multiplied by the cost per square yard to determine the cost of improving each street. The cost of each street is assessed to the adjacent blocks, half of the assessment to each side of the street, but the entire cost of intersections is met by the city at large. Fig. 2 and the notes below its title show how the plan works out.

Whenever irregular lots and irregular shaped tracts of land are located within an assessed area, the method already described is used in making the assessments, the tract being subdivided into a sufficient number of small tracts to facilitate computations.

It will be noted that this plan of assessments makes interior lots stand a part of the cost of nearby street improvements, although a small one; also that under the more usual frontage plan of assessment there are nine lots (Fig. 2) that would escape assessment.

The system of assessments described was used in 1923 and 1924 to meet the cost of grading 17.45 miles of streets and of laying 4,570 sq.yd. of concrete pavement (thickened edge type). The cost thus assessed included drainage structures. The cost of sidewalks and curbs was assessed on abutting property, except that the cross-walks at street intersections were paid for by the city. During 1923 and 1924 there were built in Baker 23 miles of monolithic concrete walks, 5.9 miles of curb, 1 mile combination curb and gutter. In the writer's opinion the cost of the curbs should be included in and assessed with that of pavements. No sewer extensions were made in the two years under consideration.

The city has no street improvement program for 1925 but when more such work is done we expect to use the plan of assessment described in this article unless something better is learned of meanwhile. Since this plan went into effect complaints against assessments have been fewer than ever before and the few complainants seem to be in the chronic kickers class.

Municipal Watershed Reforestation in New York State

FORTY cities in New York State are participating in the movement for the reforestation of idle land and have a total of more than 10,000 acres of young forests, the oldest of them being sixteen years old. Most of these city forests are planted on watersheds for the protection of municipal water supplies, and all such are game refuges under the provisions of the Conservation law which prohibits the taking of game on lands purchased or condemned for the purpose of supplying any municipality with water and protecting such supply from contamination and pollution. The tree planting was begun in 1909 and the total number of trees furnished for this purpose by the state from the nurseries operated by the Conservation Commission is more than ten million.

Various municipal agencies in the forty cities are managing the work of watershed reforestation. Sometimes it is the department of public works, as at Troy, Binghamton and Poughkeepsie. In most of the cities, however, it is the city water department, under whatever name operating, as water bureau, water-works department, water board or water commissioner, that plants the trees on the watershed; often the park commissioner or park board co-operates with the water department, but sometimes the park department uses trees on its own lands.

The city of Rochester has been active in reforestation ever since 1909 and its watershed contains 1,086,000 trees; its park department has planted 21,000 additional. Glens Falls began planting in 1910 and intends to cover its entire watershed. The hills around the reservoirs of Saratoga Springs have 1,290,000 trees planted by the municipality. Troy has planted half a million, Little Falls almost as many.

Passaic Valley Sewer Verdict Affirmed on Appeal

Federal Circuit Court Upholds Original Decision for Holbrook, Cabot & Rollins in Outfall Tunnel Case

AN APPEAL by the Passaic Valley Sewerage Commission from the noteworthy decision of the Federal District Court in the contract suit of Holbrook, Cabot & Rollins Corp., reported in *Engineering News-Record* July 3, 1924, p. 21, has just been decided by the U. S. Circuit Court of Appeals for the Third Circuit, which affirmed the district court decision in favor of the contractor. Judge Woolley, writing the decision, emphasizes and strengthens the statement of the law in the case made by Judge Bodine in charging the jury in the lower court.

After reviewing the facts of the case (for a full statement of facts see the article above cited), Judge Woolley says:

> Notwithstanding the more than 100 assignments of error [by the appellant], the case really turns on three or four questions which pervade nearly all of them, and on the law of these questions the learned trial judge had a firm hold.

On the important question of whether the sewerage commission could evade responsibility for incorrect information furnished on its drawings by the conventional note of disclaimer appended to the drawings and the corresponding clause in the specifications, placing responsibility for incorrectness of any information furnished upon the contractor, he says:

> We must accept the verdict of the jury as having established certain facts. These are, that the commissioners intended the contractor to rely upon their representations and that the contractor did rely upon them; that the representations were false in the sense of being different from the conditions which, from the borings and the disclosures made in the O'Rourke and Haskins operations, the commissioners knew to exist; that the difference between the conditions as represented and as existing operated disadvantageously to the contractor in that it called for work of a wholly different character at a highly increased cost; that the commissioners' misrepresentations, though no sinister intentions were involved, were in law technically fraudulent; and that the contractor, in consequence, suffered substantial pecuniary damage. It will be enough to say that these findings of fact are sustained by the evidence. Accepting them, as we must, the question of law is narrowed to whether the commissioners can escape liability for their conscious misrepresentations because of the note appended to the contract drawings in which they denied that their representations were warranties and disclaimed liability for what they said and did.
>
> . . . It is a familiar rule of construction that a provision in a contract repugnant to a right therein created is void. . . . [The decision then cites *Hollerbach vs. United States*, 233 U. S. 165; *Christie vs. United States*, 237 U. S. 234; and especially *United States vs. Atlantic Dredging Co.*, 253 U. S. 1, "where the self-exonerating clause in the contract there in question was similar to and just as strong as the clause here in question," as supporting its attitude.]

On the question of the right of the contractor to rescind the contract under the circumstances of the case, the court says:

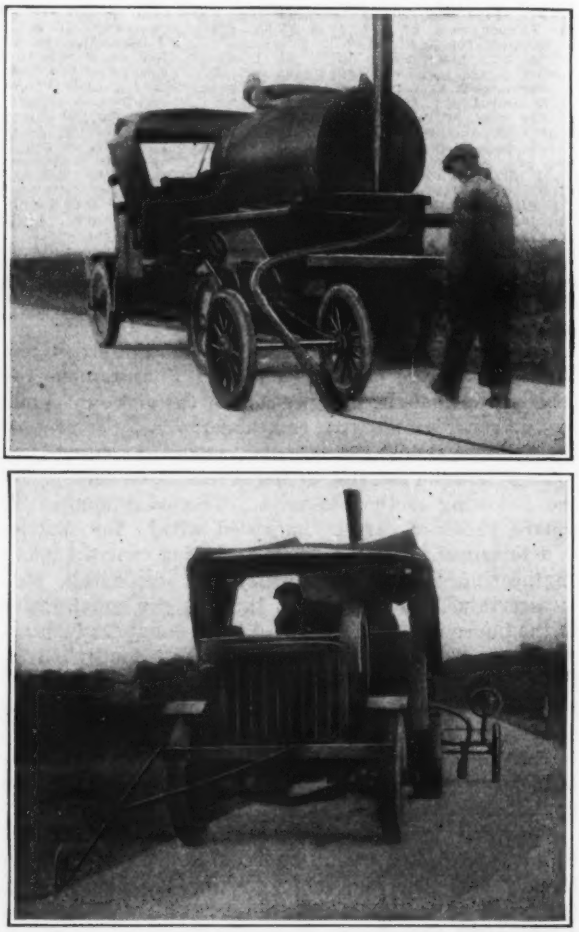
> . . . If their [the commissioners] representations were based on mistake they were sufficiently material to justify rescission, and if they were not based on mistake, the representations were, under the verdict of the jury rendered on ample evidence, either fraudulent or a breach of warranty.

The court then considers whether the contractor exercised his right of rescission promptly enough. The court finds that he did, "in the light of the magnitude of the work here involved, its difficulties, the hidden substances to be removed, and the possibility that they would change in character with each foot the tunnel was advanced."

In the lower court, the contractor was awarded damages in the sum of $816,600. This award is sustained by the decision on appeal.

Painting Traffic Line With Asphalt

ALL state roads in Delaware, approximating 450 miles, are marked with a center line to guide traffic. On the concrete roads this marking is now being done with asphalt at greatly reduced cost. Briefly stated the



FRONT AND REAR OF TRUCK FOR APPLYING ASPHALT TRAFFIC LINE

advantages found for asphalt as a substitute for white paint are: (1) It lasts longer than paint, one marking normally being good for 18 months or two years. (2) It is less expensive; with the marking outfit illustrated a road can be marked for $10 to $13 a mile while painting costs $30 a mile. (3) It is soon ready for traffic, within a few hours no damage is done by cars crossing the line.

At the costs stated the marking has been done by a tank truck fitted with a guide wheel in front and behind with a carriage, or trailer wheels, for the hose and

nozzle. Front and rear views of the marking truck are shown by the illustration. The fittings for marking were fashioned from materials in the department shops. The tank has a heater. This is important as proper temperature has much to do with the success of the painting. A good grade of asphalt smoking hot is required for satisfactory results. The stream also must be controlled. If too much is applied the stream spreads out irregularly and the film is over-thick and is picked up by the tires. It is to be noted that the strip is not painted on. The hose nozzle is small and merely feeds out a pencil stream which spreads out to a ribbon 2 in. to 4 in. wide. The cooled film should be about as thick as a silver quarter of a dollar. It will then stay put.

Criticism of the Joint Committee Concrete Column Formulas

Comparisons Between Them and Some Other Theories and Codes Show They Restrict Design

By Jacob Feld
Consulting Engineer, New York City

IN THE general affirmative tone which is noticeable in the discussions, before the various technical groups interested, of the 1924 Specifications of the Joint Committee on Concrete and Reinforced Concrete, it seems that several important points, in which these specifications are weak, are being overlooked. One of these is the section dealing with the design of reinforced-concrete columns. A comparison of the suggested rules with those of the existing New York City Building Code and with the empirical rules derived from a great mass of empirical data by John Tucker, Jr., in a paper before the American Society of Civil Engineers in 1923 ("Transactions," A.S.C.E., vol. lxxxvi, p. 1074), shows that the Joint Committee restricts the use of concrete columns to an unjustifiable extent. Especially is this true of the columns reinforced with longitudinal rods only.

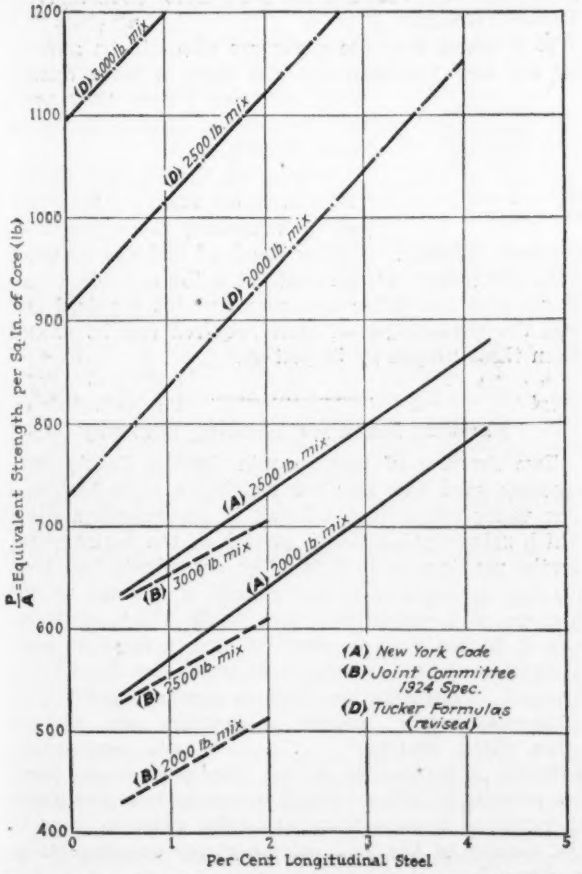

P/A = Equivalent Strength per Sq. In. of Core (lb)
Per Cent Longitudinal Steel
(D) 3000 lb. mix
(D) 2500 lb. mix
(D) 2000 lb. mix
(A) 2500 lb. mix
(B) 3000 lb. mix
(A) 2000 lb. mix
(B) 2500 lb. mix
(B) 2000 lb. mix
(A) New York Code
(B) Joint Committee 1924 Spec.
(D) Tucker Formulas (revised)

FIG. 1—EQUIVALENT STRENGTH OF CONCRETE COLUMNS WITH LONGITUDINAL REINFORCEMENT ONLY

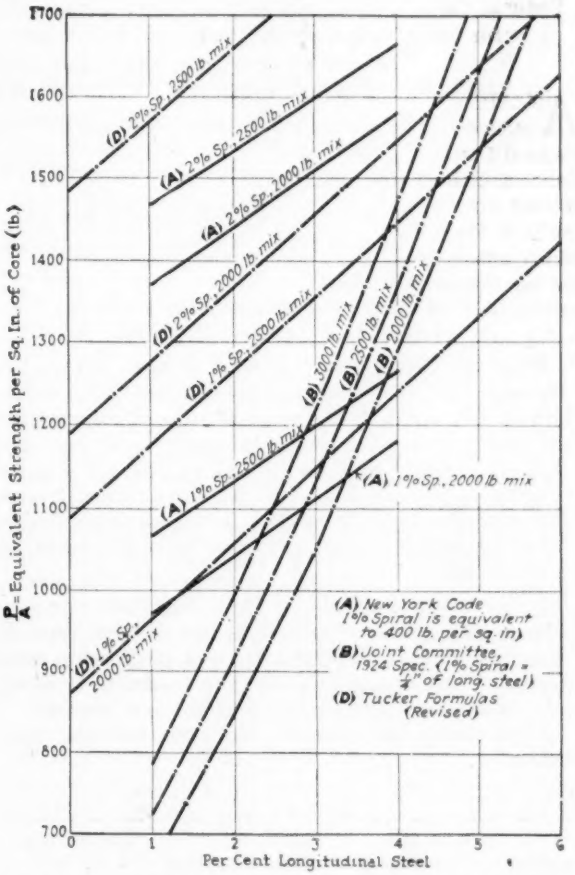

P/A = Equivalent Strength per Sq. In. of Core (lb)
Per Cent Longitudinal Steel
(D) 2% Sp., 2500 lb. mix
(A) 2% Sp., 2500 lb. mix
(A) 2% Sp., 2000 lb. mix
(D) 2% Sp., 2000 lb. mix
(D) 1% Sp., 2500 lb. mix
(B) 3000 lb. mix
(B) 2500 lb. mix
(B) 2000 lb. mix
(A) 1% Sp., 2500 lb. mix
(A) 1% Sp., 2000 lb. mix
(D) 1% Sp., 2000 lb. mix
(A) New York Code 1% Spiral is equivalent to 400 lb. per sq. in.
(B) Joint Committee, 1924 Spec. (1% Spiral = ¼" of long. steel)
(D) Tucker Formulas (Revised)

FIG. 2—EQUIVALENT STRENGTH OF CONCRETE COLUMNS WITH SPIRAL AND LONGITUDINAL REINFORCEMENT

To summarize briefly the three sets of rules, using the notation of the Joint Committee:

P = total safe axial load on the columns whose h/R is less than 40.

A = area of the concrete core within the center of the spiral wire.

A'_c = net area of concrete in column, that is, the total area less the area of the longitudinal steel.

A_s = effective cross-sectional area of the longitudinal steel reinforcement.

f'_c = ultimate compressive stress of a test specimen in 28 days.

f_c = permissible compressive stress in the concrete.

n = ratio of modulus of elasticity of steel to that of concrete, that is the ratio $E_s : E_c$.

p = ratio of the effective area of the longitudinal reinforcement to the area of the concrete core.

s = ratio of the effective area of the spiral reinforcement to the area of the concrete core.

(A) New York City Building Code: $P = (A'_c + A_s n) f_c$, where f_c = 500, for 1:2:4 concrete, and 600 for 1:1½:3 concrete.

(B) 1924 Joint Committee Specifications: $P = A'_c + A_s n) f_c$, where $f_c = 0.20\, f'_c$.

In both (A) and (B),

n = 15 for 2,000 lb. or 1:2:4 mix.
n = 12 for 2,500 lb. or 1:1½:3 mix.

(C) Tucker Formula:

$$P = 0.365(1.00 - 0.0265\, L/D)\,[(0.6 f'_c)\,(1 - p) + 31{,}000\, p].$$

Since the consensus of opinion brought out in the discussion of Mr. Tucker's paper was against a reduction of unit strength of the usual sizes of columns for the effect of L/D (length to diameter) and since the tests of concrete at Camden and at Newark Bay as reported in the supplement to the Joint Committee report show that the field concrete is as good as the design value assumed for each mix, this formula should be modified to:

(D) $P = 0.365\,[f'_c\,(1 - p) + 31{,}000\, p]$.

Tucker's reduction for slenderness in this type of column is $(1.00 - 0.0265\, L/D)$ and he assumes that concrete which tests a value of f'_c in specimens is worth only 60 per cent as much in the actual field mixture.

Substituting the constants in each formula, they reduce to:

	Values of P for		
	2000-lb. Mix.	2500-lb. Mix.	3000-lb. Mix.
(A)	$A(500 + 7000p)$	$A(600 + 6600p)$	.....
(B)	$A(400 + 5600p)$	$A(500 + 5500p)$	$A(600 + 5400p)$
(D)	$A(730 + 10600p)$	$A(913 + 10400p)$	$A(1095 + 10200p)$

Allowable Range of Per Cent
½ — 4
½ — 2
1 — 4

It should be remembered that the Tucker formulas are based upon the results of full size experiments, with the p varying from 1 to 4 per cent. The curves in Fig. 1 show the comparison between the formulas. The Joint Committee is far too conservative, not only in its allowable stresses but also in the allowable amount of vertical rods. There is no reason for limiting the p to a maximum of 2 per cent. The report of experiments on this type of column shows that the columns with 4 per cent steel tested over 110 per cent of their theoretical ultimate strength (American Concrete Institute, "Proceedings," Feb., 1915).

Similarly, the formulas for the columns reinforced with spiral and longitudinal steel, are:

(A) $P = A(f_c + (n-1)\, p\, f_c + 400\, s)$. p = 1 to 4 per cent, s = ½ to 2 per cent

(B) $P = A\, f_c(1 - p + np)$. $f_c = 300 + (0.10 + 4p)\, f_c'$. p = 1 to 6 per cent, $s = \frac{1}{2}p$.

(C) $P = 0.276\, A[0.6(1 - p)(1 + 57.3\, s)\, f_c' + 36500p]\,[1 - 0.0183\, L/D]$

Eliminating the two factors allowing for the slenderness and the uncertainty of the concrete mix, this last becomes:

(D) $P = 0.276A\,[(1 - p)\,(1 + 57.3s) f'_c + 36500\, p]$.

Substituting the constants in each formula, they reduce to:

	2000-lb. Mix	2500-lb. Mix	3000-lb. Mix
(A)	$A(500 + 70p + 400s)$	$A(600 + 66p + 400s)$	.....
(B)	$A(500 + 8000p) \times (1 + 14p)$	$A(550 + 10{,}000p) \times (1 + 11p)$	$A(600 + 12{,}000p) \times (1 + 9p)$
(D)	$A[552(1 - p) \times (1 + 57.3s) + 10{,}080p]$	$A[690(1 - p) \times (1 + 57.3s) + 10{,}080p]$	$A[828(1 - p) \times (1 + 57.3s) + 10{,}080p]$

The graphs in Fig. 2 show the relationship between these formulas. The Joint Committee formulas are again unduly restrictive, in that a maximum of only 1½ per cent of spiral is permitted and with each percentage of spiral only one percentage of vertical steel may economically be used. Of course, this tends toward standardization and the elimination of all except a few combinations of spiral and vertical steel rods. It is doubtful whether such a move is advisable until more is known of the structural value of such combinations. The permissible stresses in the Joint Committee formula for 2,000-lb. mix run higher than the values given by the Tucker formula; for the case of 4 per cent vertical and 1 per cent spiral steel, the New York Code allows an equivalent of 1,180 lb. per sq.in. on the entire core, the Joint Committee Specifications allow 1,289, the Tucker formula allows 1,237. There is a total lack of consistency between the formulas for the richer mixes; the Joint Committee values are then about mid-way between the New York Code and the Tucker formula.

It is hoped that the engineers who will be affected by the new specifications will make a more critical study of them before they voice their opinions in assent (usually by their silence).

Incidentally, these graphs make a very convenient form for designing and investigating the strength of concrete columns. Having the load and the assumed area of column core, the quotient is the equivalent unit stress over the entire core area and the required mix and the percentages of steel required can be chosen from these graphs by inspection.

Farmers Fined for Flooding Highway

Two farmers of San Joaquin County, Calif., were recently fined $50 each for flooding a state highway. The water came from a break in an irrigation ditch which submerged a 400-ft. stretch of the highway for depths ranging up to 3 ft. The defendants had been notified in advance of the danger of damage to the highway and interference with traffic which would result if ditches were not repaired, and in handing down a decision of "guilty" the court denounced their carelessness. California law declares a person guilty of a misdemeanor who "injures or destroys any state or other public highway . . . , or who negligently, willfully or maliciously drains, diverts or in any manner permits by leakage, overflow or otherwise any water thereinto or thereon from land lying adjacent to or in the vicinity of any such state highway or other public highway."

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

First Book on Reinforced-Concrete Bridges

REVIEWED BY A. BURTON COHEN
Consulting Engineer, New York City

REINFORCED CONCRETE BRIDGES: The Practical Design of Modern Reinforced Concrete Bridges, Including Notes on Temperature and Shrinkage Effects—By W. L. Scott, Assoc. M. Inst. C. E.; Chief Engineer, Considère Constructions, Ltd.; Assisted by C. W. J. Spicer. London: Crosby Lockwood & Son. Cloth; 6 x 10 in.; pp. 207; 24 halftone plates, 126 line cuts. 42s.

In the rather short introduction to this work, the first one wholly devoted to the design of reinforced-concrete bridges, the author justly points to the inherent strength of reinforced-concrete bridges as exemplified by their extraordinary resistance to demolition during the war. In the eight major subjects that follow, an effort is made to so explain procedure as to enable one to select a suitable type of structure and make a design for any case ordinarily encountered. The treatment is based on an extensive experience in bridge work carried on in England and continental Europe. It cannot be said that the work fully accomplishes its purpose since many important considerations merely mentioned require further elucidation for the engineer of limited experience. This could be done by examples of work properly designed and performed, supplemented forcefully by depicting errors of omission in existing structures, all of which, no doubt, has been comprehended in the author's experience.

There is lacking the emphatic counsel in practical considerations that often take precedence in the sequence of planning, even to the sacrifice of seeming theoretical economies in design. For example there is the fine theoretical consideration of the effect of temperature changes in arches without any consideration being given to the related problems of drainage, waterproofing and construction joints; there is explained the intricate provision of temporary hinges to compensate for shrinkage and other indeterminate stresses of construction, but no discussion of the many interesting types of arch centering, their deflections, lowering and moving, and the various methods of pouring the arch rings. The treatment of skew bridges in design and construction has not been included.

Starting with the important subject of loading, the author reviews the requirements in England and France and presents recommendations of the committee on bridges of the American Concrete Institute. One would judge the British loading, as specified by the Ministry of Transport, to be excessive, resulting in two single-wheel concentrations of 11 tons each which may pass within 1 ft. of each other. Because of such overloading of the highways, the tendency in this country is to distribute these heavy concentrations over more wheels and to further limit the bearing per inch width of tire from 800 to 1,000 lb.—a notable advancement which should be controlled by the U. S. Bureau of Public Roads and made uniform throughout all states. That the assumption made in various countries relating to the spread of concentrated loads over reinforced-concrete slabs requires further study is plainly indicated by the author's example showing a 200 per cent variation of moment. The U. S. Bureau of Highways, under the direction of Mr. Goldbeck, has carried on some very extensive research work in this field and results obtained have made possible the reduction of live-load moments to a greater extent than is credited by the author. A rule developed by M. Pigeaud of France gives by far the most liberal spread of loading, approximately one-third of the British requirement.

The use of influence lines, their applicability and expediency in design, is another major subject. The effect of point bearing of loads on arches, in so far as American practice is concerned, could have been omitted, since by various assumptions of spread through slab or fill the concentrated loading is advantageously reduced to a uniform loading. Of special interest to the American engineer are the two major subjects setting forth the European development in design and construction of the bowstring girder bridge and the use of temporary and permanent hinges in arch construction in which there has been little development in this country. The bowstring girder bridge built at Nantes, having a span of 180 ft., is a notable achievement.

The author describes and designs concrete roller bearings for concrete structures. This application of concrete seems rather precarious because of possible surface disintegrations and it is almost certain that American practice would prefer the cast-steel bearings also described.

The use of temporary hinges to offset the effect of shrinkage of the concrete in the arch ring and settlement in the abutments is a questionable expedient but an interesting one. There is a simpler method practiced here to discount shrinkage stresses, but it has no effect on the rotation of abutments as does the method proposed by Mr. Scott. This provides a key joint at the skewback to remain unfilled until the arch ring has attained initial shrinkage. These openings are of sufficient length to lap bars therein which prevents their buckling during an appreciable deflection of centering. Of particular importance is this latter arrangement when structural steel arch centering is used.

Since the book is the first one which deals entirely with concrete bridges exhaustive treatment is not to be expected, nor does the author claim it, but if more of the author's experience in construction problems affecting design had been given the work would be of far greater value.

Russian Papers on Bridge Strains

BY LEON MOISSEIFF
Consulting Engineer, New York City

Eleven papers on strains and stresses in bridges, written by various authors, have been published in Russian by the Scientific-Technical Committee of the People's Commissariat of Ways of Communication (Moscow; pp. 202; 42 plates; 3 roubles). Eight of the papers report and discuss tests made on bridges and on their details and three are of an analytical and tabular

character. Of two papers by Prof. N. S. Streletzky, one is on the dynamic co-efficient and secondary stresses, and the other on tests of the work of the details of bridge structures. Prof. E. O. Paton has a paper on the work of floorbeams of one-track railroad bridges. Among the other topics taken up are the work of metal railroad bridges under dynamic and also under live-loads; tests of a reinforced-concrete bridge under live-load; improvements in the construction of long-span masonry arches; compressive resistance of iron columns reinforced by timber pieces, and tables for the computation of common highway bridges. The papers are all written concisely. They present a good record of the practical research work which is being carried on under the Soviet regime.

Sampling and Testing Highway Materials

REVIEWED BY H. S. MATTIMORE

Engineer of Materials, Pennsylvania Department of Highways, Harrisburg, Pa.

SAMPLING AND TESTING OF HIGHWAY MATERIALS—By Wm. H. Barton, Jr., M.S., C.E., Assistant Professor of Highway Engineering, University of Pennsylvania, Formerly Highway Research Specialist, U. S. Bureau of Public Roads; and Louis H. Doane, M.S., B.S. in C. E., Associate Professor of Civil Engineering, Pennsylvania Military College, Formerly Associate Professor of Civil Engineering, Clemson Agricultural College. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 355; 83 halftones and line cuts. $3.50.

The scope of this book is fully covered by its title. It details methods for the sampling and testing of highway materials. No originality is claimed for any of the methods of sampling and test. The methods given conform with Tentative Standards or Standards of the American Society for Testing Materials, the American Society of Civil Engineers, or the American Association of State Highway Officials The authors have good judgment and show an intimate knowledge of the subject in the selection of these test methods, and also in the definition of terms relating to bituminous and non-bituminous materials. The definition for fine aggregate is an especially good one to meet general conditions.

In the Preface, the authors state that their aim was to provide a textbook and also a reference for teachers and engineers engaged in highway work. The general preparation and presentation of subject matter is in textbook form and should well serve this purpose—assuming that the instructors will elaborate and describe in detail the actions of the materials in use.

Students and laboratory operators will find the material on laboratory planning and operation given in Chapter I of great value in their work. The various chapters on materials lack interpretative comment on various tests described and also lack discussion of the specific use of materials of different qualities. This does not affect the value of the book for class-room instruction, as these subjects can be elaborated by the instructor, but this phase of the study of materials is one that is of great interest to the highway field engineer. In fact, in modern highway construction, a knowledge of the proper selection of materials is an essential. In Chapter VII, typical specifications for all highway materials in general use are given. These would be of much more value to engineers in practice if they were correlated with the test results in general notes, comments, and references accompanying the test methods.

All of the test methods given conform to good accepted practice. In many cases the authors have avoided giving the actual wording of the standards, and thus, while preserving the essential detail, have generally made them clearer for inexperienced operators. In such paraphrasing an intimate knowledge of the intent of the original standard is necessary. For sampling cement, three methods for sampling from bins are included in the standards. These three methods are given in this book, but the last one has been changed so that it is of no value as a method for obtaining the run of the bin, because it would give nothing but cement from near the top of the bin.

In a book of this kind, designed for use as a textbook or for reference, complete methods in general use should be given. Only one method, the Vicat, is given for the determination of the setting time of cement. Although many consider this the most positive and reliable of the methods available, the Gilmore determination is used to a large extent in routine testing, and is also an alternate standard.

In specifying corrugated pipe, in practice the composition of the base metal is given considerable importance, since it is one of the main factors controlling the life of the pipe. The omission of this from the section of the book dealing with corrugated pipe is especially noticeable, because in the chapter containing typical specifications, the specification for corrugated pipe gives several alternate classifications for the base metal.

To make the book more complete, test methods for such materials as stone block, wood block and asphalt block, should be given. Although these materials are not generally used to a large extent on rural highways, city pavements and highways are so closely associated in many highways that it is difficult to draw the line of demarcation.

The reviewer realizes that it is difficult to prepare a book of this general nature. The question always arises whether it should be held strictly to class-room needs or expanded into a complete reference work for practicing engineers. Judged by final results, the book under review falls in the first class. It promises to be useful and valuable for class-room work and to laboratory operators.

Wood Preservation in England

THE SEASONING AND PRESERVATION OF TIMBER: Being a Treatise on the Various Methods Employed for Drying and Preserving Timber Against Decay; With a Chapter on the Origin and Spread of Dry Rot, and the Best Method to be Adopted for Its Eradication—By Ernest G. Blake, M. R. S. L. A. B. I. C. C., Medallist in Sanitary Building Construction, etc.; Author of "Building Repairs," "Damp Walls," "Plumbing," etc. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 132; 38 halftones and line sketches. $2.50.

Various methods employed in England and on the Continent for drying and preserving timber against decay are described in this book, which also has a chapter on the origin and spread of dry rot and methods of eradication. A large amount of space is devoted to treatment with creosote, which the author states is generally considered for his country the best precaution. Creosote can be produced cheaply and in such quantities as to satisfy the most exacting demands, therefore it enjoys extreme popularity and widespread use. For this reason the fullest details are given of the various methods of impregnation. The book deals in a somewhat elementary way with growth and structure of timber and causes of decay. Other chapters cover methods of preserving timber, drying and seasoning

processes and plants, history of the antiseptic process, antiseptic processes, preservatives and descriptions of impregnating plants. It is doubtful whether a regular attendant of the American Wood Preservers Association and particularly a careful reader of its proceedings would find much new in the book. It is illuminating particularly in giving one a view of English practice. From a country that has used wood preservatives for so many years as England has, an extended chapter on results would be of decided value. The wonderful state of preservation of many impregnated objects found in the tomb of King Tutankhamen is noted but nowhere does one find experience tables of tie treatments. However, the book is a treatise on methods and the author adheres to his subject.

Boundary Survey

JOINT REPORT UPON THE SURVEY AND DEMARCATION OF THE BOUNDARY BETWEEN THE UNITED STATES AND CANADA, From the Source of the St. Croix River to the St. Lawrence River, In Accordance with the Provisions of Article III of the Treaty Signed at Washington, April 11, 1908—His Britannic Majesty's Commissioner: W. F. King, 1908-1916, J. J. McArthur 1917—; United States Commissioner: O. H. Tittmann, 1908-1915, E. C. Barnard, 1915-1921, E. Lester Jones 1921—. Washington, D. C.: International Boundary Commission. Cloth; 10 x 12 in.; pp. 512; many halftones, drawings; maps, tables; index.

Though a straightforward report of a government commission this book contains many high lights of romance one may expect to be derived from difficult surveying in a wild country. It is but one of a series of reports covering retracement and remonumenting of the international boundary, concerning itself with a 670-mile strip between Canada and Maine, New Hampshire, Vermont and New York. Difficulties met in transporting men and equipment, in searching for the original boundary monuments set in 1845 and in establishing bases for precise traverse and triangulation give the volume much worth as popular reading besides making it a valuable addition to surveying literature.

PUBLICATIONS RECEIVED

INTENSIVE STUDIES of regional market practices and methods, purchasing power and inclination to buy, and related data have been undertaken by the U. S. Department of Commerce. The first of these to appear (No. 1, Domestic Commerce Series; 20c. from Superintendent of Documents, Washington, D. C.) is Commercial Survey of the Philadelphia Marketing Area, by J. Frederic Dewhurst. It reviews the general character of the area, its various productive industries, its commerce and distribution and regional markets. County and regional statistics are given in an appendix.

THE TRANSACTIONS of The First World Power Conference, noted on p. 154 of our issue of July 28, can now be obtained in this country from D. Van Nostrand Co., 8 Warren St., at $70 per set, including the index.

IN THE NOTICE of the new edition of the bulletin on "Effect of Hydrated Lime and Other Powdered Admixtures on Concrete," published in our issue of Aug. 20, we omitted to state that copies of the bulletin may be obtained from the Portland Cement Association, 111 West Washington St., Chicago.

THE INSTITUTION OF CIVIL ENGINEERS COMMITTEE on the Deterioration of Structures in Sea Water has made its fifth interim report on an investigation which is being carried on with typical British thoroughness. The pamphlet (66 pp.) contains several brief reports on test operations, mainly on the effect of sea water on certain wooden and metal structures. The report is published at 3½ shillings net, by H. M. Stationery Offices, which has agencies in various parts of the world, including 28 Abingdon St., London, S. W. 1, England; 87 Queen St. East, Toronto, Ont.; British Library of Information, 44 Whitehall St., New York City.

THE HYDRO-ELECTRIC POWER OF TASMANIA, a description of the Great Lakes hydro-electric development and of the Tasmanian electric supply system, has been published under the authority of the Hydro-Electric Department of Tasmania. The pamphlet gives a detailed description of this rather remarkable power development with an installation of 58,000 hp. on the Island of Tasmania. (The Hydro-Electric Department, Tasmania; or Tait Publishing Co., Ltd., Sydney, Australia, 2s. 6d.)

THE PAPER AND DISCUSSION on Brass and Copper for Water Service and Plumbing Pipe read last March before the New York Section, A. W. W. A., and printed in the August *Journal* may be obtained as a separate pamphlet from the author, William G. Schneider, Research Department, Copper and Brass Research Association, 25 Broadway, New York City.

DRAINAGE LAWS of Minnesota, including those passed in 1925, have been published as a 215-p. pamphlet arranged and annotated by E. V. Willard, commissioner, Drainage and Waters, St. Paul, Minn.

New Books and Revised Editions

[*Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.*]

BEKNOPTE SAMENVATTING VAN HET UITGEWERKT PLAN, Betreffende eene Centrale Drinkwatervoorziening voor Noord-Overjissel, Opgemaakt door het Rijksbureau voor Drinkwatervoorziening in opdracht van het College van Gedeputeerde Staten der Provincie Overjissel. 's-Gravenhage, Holland: Rijksbureau voor Drinkwatervoorziening. Paper; 8 x 13 in.; pp. 32; map and tables.

Two district water supply systems for portions of Holland, described by W. F. J. M. Krul, director of the bureau of water supply, Province of Overjissel.

CONCRETE, PLAIN AND REINFORCED, Vol. I: Theory and Design of Concrete and Reinforced Structures—By the Late Frederick W. Taylor, Sanford E. Thompson, S. B., and Edward Smulski, C. E.; with a chapter by Henry C. Robbins. Fourth Edition. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 969; 311 line cuts and halftones in text, section of tables and diagrams. $8.

DIE WASSERKRAFTNUTZUNG IN OSTERREICH UND DEREN GEOGRAPHISCHE GRUNDLAGEN—Von Bartel Granigg, Leoben. Vienna: Julius Springer. Paper, 8 x 11 in.; pp. 123; 17 line cuts, 4 colored plates, one geographical table. Paper, 13.3 marks, bound, 15 marks, in Vienna.

ELEMENTARY GUIDE TO REINFORCED CONCRETE: A Simple Explanation of Reinforced Concrete Design and Construction Specially Written for the Student, the Clerk of Works, Foreman, and Others Interested in Concrete—By Albert Lakeman, Chartered Architect, Licentiate Royal Institute of British Architects, M. Institution Structural Engineers, Honours Medallist Construction, Late Lecturer Woolwich Polytechnic. London: Concrete Publications, Limited. Paper; 6 x 9 in.; pp. 69; 79 line cuts. 2 shillings.

HYDRAULICS AND ITS APPLICATIONS—By A. H. Gibson, D. Sc., M. Inst. C. E., M. Inst. M. E., Beyer Professor of Engineering in the University of Manchester (England). Third Edition. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 801; 426 line cuts and halftones. $6.

This work has been brought to date, in the present edition, the author states in his preface, by much rewriting. Because of the rapid development in the past ten years in the design of hydraulic prime movers, the section dealing with turbines has been recast, and a section has been added dealing with the wave transmission of energy in pipe lines. A chapter has also been added dealing with the principle of dynamical similarity and its applications to fluid motions and resistances, and the section dealing with the measurement of fluid flow has been largely extended. The first edition of the work was reviewed in *Engineering News*, Nov. 12, 1908, by Gardner S. Williams, and the slight changes that were made in the second edition were outlined in *Engineering News-Record*, March 16, 1922.

RAHMENFORMELN: Gebrauchsfertige Formeln für einhüftige, zweistielige, dreieckformige und geschlossene Rahmen aus Eisen- oder Eisenbetonkonstruktion nebst Anhang mit Sonderfällen teilweise und ganz eingespannter sowie durchlaufender Träger—Von Prof. Dr.-Ing. A. Kleinlogel, Privatdozent an der Techn. Hochschule, Darmstadt. Fünfte neubearbeitete und erweiterte Auflage. Berlin: Wilhelm Ernst & Sohn. Paper; 7 x 9 in.; pp. 412; 689 Rahmenfälle mit 1350 abbildungen. Paper, 18 marks, bound, 19.5 marks, gold, in Germany.

The first edition of Dr. Kleinlogel's collection of formulas for determining stresses in simple frames with stiff angles was reviewed by Leon S. Meisseiff in *Engineering News* for Jan. 21, 1915, p. 119. In successive editions the number of formulas has been increased until now 689 are presented.

Letters to the Editor

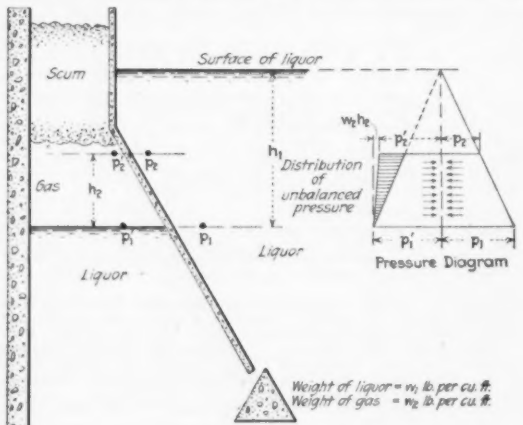
This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Fort Worth Imhoff Tank Accident

Sir—We have read with interest the article by John B. Hawley on "Accident to Imhoff Tank Unit at Fort Worth, Texas," in your issue of July 9, p. 54. Much information that would be of value in determining the cause is not given. For example, nothing is stated as to whether the level of the liquor in the tank was lowered below the effluent weirs by the accident or as to whether the scum remained in place (sealing the vent) after the accident. Such information, if available, would go far toward establishing the existence, or non-existence, of a layer of gas below the scum; and if obtained immediately after the accident would have furnished the means of making a fair estimate as to the quantity of gas.

If the scum accumulated to such an extent that it became gas-tight, any accumulation of gas whatsoever beneath the scum would create an unbalanced pressure upon the thin partition wall. The scum would have a greater pressure to resist than the wall due to the fact that the wall is aided by the water pressure on the other side, but it is conceivable that 2½ ft. of scum thoroughly wedged between the walls might resist a considerable pressure.

In the accompanying sketch, the pressure p'_1 equals the pressure $p_1 = w_1h_1$ (the weight of the column of liquor



PRESSURES IN FORT WORTH IMHOFF TANK

above p_1). The difference in pressure, $p'_1 - p'_2$, is due solely to the weight of the column of fluid between the two horizontal planes passing through the two points, as is the case also with the differential pressure, $p_1 - p_2$. Hence the pressure.

$$p'_2 = w_1h_1 - w_2h_2$$

and

$$p_2 = w_1h_1 - w_1h_2$$

Therefore the unbalanced pressure developed at the top of the gas layer is

$$p'_2 - p_2 = (w_1 - w_2)h_2$$

The total unbalanced pressure, and its distribution, is shown hatched on the pressure diagram.

An estimate of the weight of the gas, w_2, will show it to be negligible in figuring pressures. Assume for an extreme figure that it weighs twice as much as air, or that its specific volume, $v_1 = 6$ cu.ft. (per pound of gas). Assume also that it is under a head, h_1, of 6 ft. Then the compressed volume of a pound of the gas is

$$v_2 = 34 \div 6 = 5.1 \text{ cu.ft.}$$

That is to say, if h_2 is as much as 5.1 ft. the difference in pressure, $p_1' - p_2'$, is only 1 lb. per square foot.

Neglecting the weight of the gas, then, the unbalanced pressure is

$$p'_2 - p_2 = w_1h_2$$

Assuming a layer of gas 4 ft. in thickness, the unbalanced pressure at the top of the layer would be approximately 250 lb. per square foot.

The writers, being familiar with the design of the Fort Worth tanks, are aware that the 3-in. partitions will not withstand any such loading. Even if they would, there is nothing to prevent the gas from accumulating (except the strength of the scum layer which might be enormous) until the loading should reach the ultimate for the walls. The remedy, therefore, in the opinion of the writers, is not to strengthen the slab, but rather to keep the gas vents open so that they are vents. It is a problem of operation rather than of design.

THOMAS R. CAMP,
and C. F. LEWIS,
Of Spoon & Lewis, Consulting Engineers.

Greensboro, N. C.,
July 25, 1925.

An Early Patent in Aerial Surveying

Sir—In *Engineering News-Record*, April 9, 1925, p. 604, appears an article describing the successful application of aerial photographic plan views in making accurate topographic maps, including contours. It will be appreciated by any one who thoroughly comprehends the process described that the essential method is the taking of two overlapping plan views of the same tract, from different positions, and utilizing the combined distortions of perspective in the two views, to obtain the correct horizontal position and relative elevations of all points appearing in both views.

The office work on the photographs admits of many variations that are merely minor details in the application of the essential method, which consists in combining the perspectives of two overlapping plan views. This method is my invention, patented December, 1893, and published in the *Patent Office Gazette*, under number 510,758.

The idea was conceived and worked out by me, in theory, in the summer of 1892; and I submitted a full description to the United States Engineer in charge of harbor work at Savannah, Georgia, Captain Oberlin Carter, for his opinion as to its practicability. Whether he communicated his knowledge, so obtained, to anyone else I do not know. I think not.

During 1893, and while the issue of my patent was pending, I tried to interest the United States Coast and Geodetic Survey in experimenting with the method. They took photographs of my apparatus, and copies of a little brochure I had written, describing the method and its practical application; but I could not induce them to spend money in experimenting with the method. It was clearly an invention in which it was difficult, if not impossible, to interest private capital, and so for fifteen years the invention lay dormant.

In the summer of 1908, the Wright brothers having made aeroplanes a success, and the army having made successful experiments with dirigibles, I thought the time opportune to try again to interest the government in my method. Accordingly, I made a trip to Washington in August of that year, and submitted full descriptive matter relating to my method to the Geological Survey, and to the General Staff of the United States Army. The director of the Geological Survey returned my papers in December of the same year. The General Staff of the Army, under orders of General J. Franklin Bell, then chief of staff, filed the papers for investigation and study.

It now appears that they must have begun experiments with my method not very long thereafter; and that they prosecuted these experiments through a period of ten years, in perfecting the technique of practice. But a careful comparison of my patent papers and my brochure and drawing, with the perfected process now successfully used, will show that nothing material has been added to the original conception, except the details of the office work, which depend for their value entirely on the essential method invented by me which marks the step from bird's-eye views to correct plans from aerial photographs.

The General Staff did not notify me that they were to experiment with my invention, nor invite me to witness or

co-operate in the work, all of which was due me as the inventor; and I did not know of their work until your article of April 9 appeared.

C. B. ADAMS,
Assistant Engineer, Department of the Interior, Porto Rico.

Quebradillas, Porto Rico,
July 12, 1925.

[Inquiry to the War Department regarding the claims set forth in Mr. Adams' letter has elicited the following two replies.—EDITOR.]

Sir—Search of old stored records has developed the fact that there was received in this office, about Aug. 25, 1908, by reference from the Chief of Staff, a communication dated Aug. 19, 1908, with three enclosures, from a Mr. Cornele B. Adams, of New Orleans, La., descriptive of a method of photogrammetry invented by him.

Mr. Adams was not in any way connected with army signal work. The papers descriptive of his method or scheme left this office by reference to a Board on Equipment. It is impossible for this office to determine at this late date the consideration given or the action taken by that board.

FOR THE CHIEF SIGNAL OFFICER,
ALVIN C. VORIS,
Lieut. Col., Signal Corps.

Washington, D. C.,
Aug. 11, 1925.

Sir—An extended search of the available records and files has been made in an effort to locate any correspondence and record relating to the submission to the War Department by Mr. C. B. Adams of a method of aerial surveying.

The Air Service was not created until ten years after the submission made by Mr. Adams and no records relating to the transaction exist in this office, and the effort of the Signal Corps [noted in above letter—EDITOR] was encountered in extending the search beyond the records of the Air Service. No information additional to that supplied to you by the Signal Corps has been discovered in the War Department.

J. E. FECHET,
Brigadier General, A. S.,
Acting Chief of Air Service.

Washington, D. C.,
Aug. 14, 1925.

[All of the foregoing correspondence was submitted to F. E. Weymouth, president of Brock & Weymouth, the firm controlling the method of aerial surveying described in the article of April 9, which led Mr. Adams to write the first letter in this series. Mr. Weymouth has replied as follows.—EDITOR.]

Sir—The statement evoked from C. B. Adams by your article of April 9 on the Brock process of mapping has been read with much interest and we greatly appreciate your courtesy.

We are familiar with Mr. Adams' contribution to the theory of aerial mapping as disclosed in his U. S. Patent 510,758 of 1893, which expired in 1910, but we cannot regard it as describing or anticipating any of the essential features of the Brock process, which make the latter commercially effective.

Mr. Adams suggests means for making exposures above previously selected points by a camera sent above such points to a predetermined height, automatically operating mechanism making the exposure when this height is reached. He then proceeds to explain how the conic projection of the views so obtained can be converted to the orthographic projection of maps, and that this operation is not affected by variations in elevation of the viewpoints of the pictures so converted. This, in fact, must be considered as Mr. Adams' contribution to the art.

Beyond this his patent describes in some detail the geometrical features of conical projections which may be used to construct the orthographic projection in plan view and to determine ground elevations of various plotted points. This study was, however, by no means new in 1893, having been exhaustively dealt with by French and Austrian army officers many years before this date. The publications on this subject by Col. Laussedat date back to 1859.

Mr. Adams describes how by graphic methods a topographic map may be constructed. Although his conclusions in this respect are theoretically correct, provided he has horizontally projected views to work with, none of the means he indicates will yield results of any value, solely because the direct measurement of either angles or distances from the sharpest photographic views cannot be done with the degree of precision required for topographic maps. Furthermore, the necessity of securing a measured base length between points of equal elevation for each succeeding view is in itself enough reason to discard the Adams method for the purposes of commercial topographic map production.

The problems met and solved by Mr. Brock and his staff were those of finding practically efficient means to recognize and to correct lack of horizontality in the aerial views and to construct instruments of adequate refinement to measure angles and distances with the degree of precision required to yield dependable conclusions of orientation and elevation. The Brock measuring stereoscope or stereometer and correcting projector are the principal means used by them, and have proved themselves in numerous instances and without exception to be adequate instruments when used in connection with numerous other features of refinement. So far as the record shows, none of these was anticipated by Mr. Adams, and hence it seems necessary to reject any claim by him to inventorship of the Brock process.

Mr. Brock and his associates had to deal with modern aeronautical development. Instead of raising balloons in predetermined points, they mounted a camera in a fast-flying airplane and consequently had only very limited control over the location of ground points above which successive exposures are made, and a somewhat better, but nevertheless insufficient control over the exact elevation in which exposures are made. This left them thus without two essential points of information, which therefore had to be secured in some way and is secured by them with the aid of means not even hinted at in Mr. Adams' disclosures. They could never rely on the horizontality of the aerial views and had to devise ways and means to recognize errors in this respect and to correct them. It seems thus that Mr. Adams rather over-claims the facts when he asserts that he had accomplished such results in 1893.

Finally, the Brock process was not worked out in co-operation with the U. S. Army or any other outside agency. It was developed exclusively by Mr. Brock and his staff.

F. E. Weymouth,
President, Brock & Weymouth.

Philadelphia, Pa.,
Aug. 27, 1925.

Drains Under Earth Dams

Sir—G. S. Williams in his letter on the above subject published in your issue of June 25, 1925, p. 1070, is of the opinion that the line of saturation, by the installation of drain pipes in the downstream section of the dam, is approximately 15 deg. to the vertical and when there are no drain pipes the line of saturation assumes a slope of nearly 2 to 1. But from the experiments conducted by the engineering irrigation department of Bombay Government it has been found that the line of saturation assumes a

TYPICAL EARTH DAM SECTION, BOMBAY GOVERNMENT

slope of 4 to 1 in case of dams the downstream sections of which were not drained.

Generally in cases where the rear base is drained the rear slope is kept at 2 to 1. But in case where the rear slope is not drained the rear slope is kept at 4 to 1 so that there is always 4 ft. of section of the dam above the line of saturation as shown in the sketch. It is better not to go in for drains and induce passage of water through the dam. But in cases where the dams have shown signs of sloughing the installation of drains in the downstream section has been successful. It is only by a watertight construction with sufficient width of base and a good selection of materials that a stable earthen dam can be constructed.

C. C. DALAL,
Assistant Engineer, Investigation Division,
Nizam Sagar Project.

Nizamabad, Nizanio Dominions, India,
Aug. 1, 1925.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Water-Works Convention on St. Lawrence River

Sessions on Boat, Golf and Side Trips Ashore—Dexter Brackett Medal Goes to R. E. Horton

Participants in the New England Water-Works Association rail-and-water trip on Sept. 8 to 12 to the Thousand Islands and through the St. Lawrence and Saguenay Rivers, with stops at Alexandria and Murray Bays, Tadousac, Quebec and Montreal, that constituted the 44th annual convention of the association agreed that the excursion was most enjoyable and that holding the sessions of the convention aboard ship worked admirably. It was necessary to cut out the usual exhibit conducted by the Water-Works Manufacturers' Association. Day time stops gave an opportunity for golf at four or five points on the trip. Only 257 went on the excursion, including many women, children and other guests and a goodly number of representatives sent by the associate members.

Technical Sessions

The address of the retiring president, S. H. Taylor, superintendent of water-works, New Bedford, Mass., was confined to the course of association matters during the past year. Seven technical and business sessions were held aboard the S. S. "Richelieu." There was but little official business to transact. The count of ballots for officers showed that of 287 ballots cast nearly all were for Theodore L. Bristol, president, Ansonia Water Co., Ansonia, Conn, as president, and Frank E. Winsor, chief engineer Water Supply Board, Providence, R. I., as vice-president. Members of all classes totaled 751 on Aug. 31, a net loss of 7 for the year. In contrast with this small loss in membership, there was a gain of about $2,500 in the funds of the association during the year. Creation of a committee on scoring the sanitary condition of water supplies was authorized.

The Dexter Brackett Medal (for the best paper printed in the *Journal* during 1924) was awarded to Robert E. Horton, consulting engineer, Albany, N. Y., for his paper on "Determining the Mean Precipitation on a Drainage Area" (see *Journal*, March, 1924). This is the second award to Mr. Horton.

All of the 15 technical papers on the program were available, but the authors of only half of them were present. Nine of the fifteen papers scheduled were by consulting engineers (including one college professor) but in one case the chief and resident engineer of the water-works and in another case the superintendent of water-works collaborated. One was by a chemist of a state board of health, two by filter-plant engineers, one by the manager and chief engineer of a water-works system and but one by a man with the plain title of superintendent of water-works, and he was the retiring president of the association. Four of the papers were postponed to one of the coming winter meetings of the association. Abstracts or brief mention of the other papers begin on p. 469 of this issue.

Engineering Fifty Years Ago

From *Engineering News*, September, 1875

European Demand for American Engineering Instruments

MATHEMATICAL Instrument Makers of Philadelphia, have recently received and are now filling heavy orders for Engineering Instruments (Transits and Levels) from Vienna, Germany, and from Bristol, England. When it is recalled to mind that up to within a comparatively recent date all the most accurate instruments of this class have been imported from Europe, and that this is the first instance known where instruments of this class have been imported into Germany from this country, this fact is deemed worthy of notice.

Charles A. Magrath Made Head of Ontario Hydro Commission

The Ontario Government has appointed Charles A. Magrath, chairman of the Canadian Section of the International Joint Commission, to be chairman of the Ontario Hydro-electric Power Commission to succeed the late Sir Adam Beck.

The new chairman has devoted many years of his life to public service. He was born in Grenville County, Ontario, in 1860 and spent many years of early life in Western Canada on survey work. In 1911 he was appointed to the International Joint Commission. In 1913 he was chairman of a commission created by the province of Ontario to report upon a comprehensive system of highways. This commission issued a report in 1914, upon which all subsequent work on the provincial roads has been based.

Mr. Magrath is a former president of the Dominion Land Surveyors' Association of Canada, and a prominent member of the Engineering Institute of Canada. During the war he was a member of the War Trade Board of Canada. From 1917 until 1920, he was fuel controller for Canada and since 1922 has been a member of the federal advisory fuel committee.

Upper Basin Governors Take Stand on Colorado River

Governors of Colorado, Wyoming and Utah Reply to Ultimatum by Arizona Governor

After the conference on Aug. 29, noted briefly in our issue of Sept. 10, p. 444, the governors of Colorado, Wyoming and Utah issued in the form of an address to the citizens of the upper basin states a statement purporting to express the attitude of these states on Colorado River problems. The statement opposes the construction of any flood control works before the Colorado River compact (the seven-states compact, drafted in November, 1922) is ratified and in force. Subsequently, the governor of New Mexico, who was prevented from attending the conference, endorsed and accepted it for New Mexico.

The governors open their statement with the assertion that "The construction of enormous works on the lower river, which might give rise to assertions of claim to monopolistic and exclusive use of our waters, would be destructive to our institutions and inimical to our welfare unless adequate protection is provided in advance of such construction. The Colorado River compact affords this protection. It protects the future development of the upper states without injury to the states of the lower basin." They then review the Colorado River situation, beginning with the break of the river into the Imperial Valley in 1905, and tell of subsequent pleas of Arizona and California to the upper basin states to assist in bringing about flood control and river regulation. Upon this, "moved by considerations of humanity and immediate necessity, the governors of the Colorado River states met at Denver, May 10, 1921," in the preliminary steps to bring about a Colorado River partition agreement, and such an agreement was subsequently drafted and signed by a duly appointed joint commission at Santa Fe, N. M., Nov. 24, 1922. The failure of Arizona to ratify this compact is then recited, as well as the action taken by the other six states in 1925 to ratify the agreement as a six-state compact, which ratification was nullified by reservations attached by the California legislature.

Governors' Ultimatum

The governors then say, in the name of the upper basin states:

"Our proffers of co-operation and goodwill have been ignored; our silence has been misconstrued; threats of groundless litigation against us are being encouraged and efforts are being made to secure the construction of enormous works along the lower river, without our consent and without regard to future necessities and the welfare of our commonwealth.

"We stand now, as we have consistently stood throughout all negotiations, for prompt action that will provide adequate flood control in the lower basin of the Colorado River, but, as an economic proposition, such flood-control works should not be constructed unless the waters controlled are also appropriated and utilized for profit in the production of power and for other purposes. To make claim to waters of the river under such appropriations without first protecting the upper states by an equitable division of the waters as provided in the compact, would menace future development in those states. This must not be.

"We cannot and will not co-operate with the lower basin states until protection is afforded our states by compact between the states interested. To that end, the representatives of our states are at all times ready to meet the representatives of the lower basin states, together with those of the federal government, to discuss and effect plans whereby flood control and full development of the river may proceed.

"Therefore, pending and until the approval of the Colorado River compact, considerations of self-preservation compel us to oppose the construction of any works for flood control, power development, or any other uses, and we call upon the senators and representatives in congress of the States of Colorado, Nevada, New Mexico, Utah and Wyoming and the public officials of said states, to use every legitimate means to protect the rights of our states as set forth herein.

"We commend and endorse efforts now in progress to bring about co-operative action by citizens to organize for the common purpose of protecting present and future development in the upper states.

"We earnestly ask the attention of the subcommittee of the committee on irrigation and reclamation of arid lands of the Senate of the United States, authorized to proceed during the month of October to make a close and intimate study of the problems of the Colorado River basin, to the point of view of the upper states, as set forth in this address."

How Lower Basin States Split on Colorado River

Detail reports of the tri-state conference of California, Nevada, and Arizona, held at Phoenix, Ariz., on Aug. 17, show the reason for the breaking up of the conference before the business for which it was appointed was taken up. The point on which the conference split was a declaration in favor of Boulder Canyon. Following the opening address of Governor Hunt of Arizona *Engineering News-Record*, Sept. 3, 1925, p. 398, the Nevada delegation, seconded by the California representatives, demanded that the Arizona representatives agree to a stipulation favoring the construction of the Boulder Canyon project, before consideration would be given to questions of allocation of water or power. The Arizona representatives declined to commit themselves to such a stipulation without a more specific indication concerning the project in question—its size and location, and more particularly the method of financing, control and allocation proposed. They asserted that Arizona had not opposed construction of storage at Boulder Canyon, as implied in the wording of the stipulation as formulated by Senator Swing, one of the California representatives. Proposals of Arizona to proceed to a consideration of the matter for which the conference was called met with no response on the part of the California and Nevada representatives, and the conference ended, having lasted less than one day.

Bridge and Power Export Issues Approved in Maine

The most recent returns from the state of Maine indicate that the proposed bond issues of $3,000,000 for a bridge across the Kennebec River at Bath and of from $10,000,000 to $20,000,000 for highway construction, and the constitutional amendment in favor of the export of electric power have passed by a large majority. The power amendment was proposed in order to foster the scheme for the development of tidal power on Passamaquoddy Bay.

Progress Reported on Cement Investigation

At the Bureau of Standards, Washington, on Sept. 10, the staff engaged in the co-operative research into the nature of portland cement reported to a visiting body of representatives of the Advisory Committee of the Portland Cement Association and of the Committee on Cement of the American Society of Civil Engineers. This co-operative research, it will be remembered, is being undertaken by the Bureau of Standards with the assistance of the Portland Cement Association, the work being carried on under the direction of P. H. Bates, of the Bureau of Standards, with R. H. Bogue in direct charge of the work as research director for the Portland Cement Association.

The report consisted in a statement by Director Bogue of the progress the work has made and specific demonstrations by each individual specialist of the particular investigation which he is carrying on. This consisted in illustrations of new high temperature furnaces, of some equilibrium studies and preparation of pure cement compounds, some insertions of the studies on thermal reactions during setting, and measurement of flow of portland cement, and the petrographic analyses of clinker. It was further explained that it is the intention soon to initiate work on the application of X-ray methods to cement research in the hope that some revolutionary uses of the X-ray spectrum may develop.

So far the investigation has confirmed the theory of the composition of portland cement advanced some years ago by the Geophysical Laboratory at Washington and seems to contradict some of the more recent European theories, particularly the Janecke and Dyckerhoff theory that the essential element in portland cement is a new compound composed of 8 parts lime, 1 part alumina and 2 parts silica.

Philadelphia Votes Large Amounts for City Work

Two loan bills for a total amount of $34,500,000 were approved by the electors of Philadelphia at the primary election on Sept. 15, 1925. One of the loans provides for increasing the city indebtedness $29,750,000, the money to be used for the following purposes:

Completion of the Broad St. subway and construction of other transit facilities in accordance with the transit plan, Step No. 1 approved last year	$18,000,000
Completion of the Art Museum	1,200,000
Sewer construction	3,500,000
Bridge construction	1,500,000
Street grading, widening, etc.	3,000,000
Park improvements, golf courses, etc.	1,550,000
Damages for street improvements	1,000,000

The other loan bill provides the sum of $4,750,000. Of this sum $300,000 is to be used for construction and equipment of the city asphalt plant; $250,000 is to be used for construction of a new floor system on the Girard Ave. bridge over the Schuylkill River; $150,000 is to be used for the purchase of fire apparatus; and the balance of $4,050,000 is to be used for various items of street grading and paving.

New Developments in American Association of Engineers

Revision of the basic structure of the American Association of Engineers in accordance with the demands of the members as expressed in a recent referendum was the outstanding result of the meeting of the board of directors held in Chicago on Sept. 12. A referendum of the membership resulted in a vote of more than four to one in favor of separating national and chapter dues and a similar favorable vote was recorded on other questions designed to open the way to reduced operating costs and to provide a maximum of self government and efficiency within the organization.

Another basic change was in the elimination of grades of membership such as used by technical societies which, in the opinion of the board of directors, are not suited for a professional organization devoted to engineering welfare work such as the American Association of Engineers. Three classes of membership are now provided for: member and affiliate member with dues at $7.50 per annum and junior member (a student formerly) at $2.00.

The new program contemplates a nation-wide survey of the supply and demand of engineers to be carried on in co-operation with other national bodies and enlarged placement service for engineering employees is also planned.

In order to emphasize the importance of ethical service in the professional work of the engineer, a "Vow of Service" will be devised to be used in the graduating exercises at engineering colleges and in the admission of engineers to professional society.

The employment of a secretary was deferred until such time as the finances of the association are in better shape.

Bridge Approach to New Terminal at Cleveland Approved

The Chief of Engineers has approved the application of the Cleveland Union Terminals Co. for a permit to build a fixed bridge over the Cuyahoga River at Cleveland, Ohio, at a point 235 ft. west of Columbus Road. The structure is to have a vertical clearance at low water of 98.4 ft. The channel width is to be 152 ft. with provision for its increase to 200 ft. when the needs of commerce demand.

Water Power to Be Developed in the Ohio at Louisville

The Federal Power Commission has issued a license to the Louisville Hydro-Electric Co. for the construction of a hydro-electric plant at the falls of the Ohio, Louisville, Ky., and the construction of the power plant will be commenced immediately. The complete development of the river at this point is to be undertaken jointly by the government and the power company, the government to build a dam nearly 2 miles long across the Ohio River as part of the plan to establish a 9-ft. stage of water for navigation from Pittsburgh to Cairo. This dam will extend from the Indiana shore to Rock Island near the Kentucky shore and the power company will build its power house between this island and the shore close to the site of the old town of Shippingsport. The estimated cost of the dam is $3,250,000 and of the power development, $7,500,000.

The power plant will contain 8 hydro-electric units of 13,500 hp. each, a total of 108,000 hp., with provision for an ultimate capacity of 135,000 hp.

Delaware River Bridge Deadlock on Tolls Continues

Developments in the controversy between the states of Pennsylvania and New Jersey concerning toll collection on the Delaware River bridge (under construction) have made the situation decidedly more acute. As reported Sept. 3, p. 399, the New Jersey bridge and tunnel commission on Sept. 1 voted to award no further contracts until assurance has been obtained that tolls would be collected for interest and amortization of the New Jersey bonds issued to pay for the bridge.

At a special session of the New Jersey state senate on Sept. 8 a resolution was passed asking Governor Silzer to call a special session of the legislature at the earliest possible moment in order that the situation concerning the Delaware River bridge might be reviewed and "adequate and effective legislation passed." The resolution states that New Jersey is by legislation definitely committed to the charging of tolls to be applied toward the payment of the bonds issued by the state for the building of the bridge, "and such tolls should therefore be imposed and continued until the construction cost and the bonds issued therefor shall have been paid."

W. J. Douglas Made Consulting Engineer on Arlington Bridge

Lieut. Col. C. O. Sherrill, Corps of Engineers, the executive and disbursing officer of the Arlington Memorial Bridge Commission, has announced that W. J. Douglas, of the firm of Parsons, Klapp, Brinckerhoff and Douglas, has been appointed consulting engineer on the Arlington Memorial Bridge across the Potomac River at Washington. The firm of McKim, Mead & White were retained in connection with the architectural features during the stages of preliminary planning and will be continued on this work. The engineering plans for the bridge are being prepared in Col. Sherrill's office under the Design and Construction Division of the Office of Public Buildings and Public Parks, which division is in charge of Major Joseph C. Mehaffey. John L. Nagle is the chief designing engineer, assisted by J. C. Spotts. Earl G. Marsh is assistant engineer in immediate charge of field construction.

The Arlington Memorial Bridge is to cross the Potomac River on a line approximately between the Lincoln Memorial and the Arlington homestead. Congress has authorized $14,000,000 for the structure, to be expended over a considerable period of years. The appropriation is to be made as needed. Borings are now under way for the bridge and contracts for foundation work are expected to be let within two months.

New Phases of Reclamation

Special Correspondence

Oregon legislators have threatened to overthrow the policy of the federal administration with regard to new reclamation projects. They are not expected to make much headway at the forthcoming session of Congress, however, according to competent opinion at Washington. Apparently they are unaware that the agricultural interests generally are insisting that the government be protected against further losses on the old projects and that the solvency of new projects be assured before construction begins, on the ground that it is unfair to farmers elsewhere for the government to subsidize certain farming operations with which other farmers have to compete. Moreover, some reports reaching the Capital indicate that the policy of the Interior Department in regard to new projects has support in Oregon as well as elsewhere. The state grange is supporting the national body in opposing new projects.

Crib of Buffalo-Fort Erie Bridge Breaks Away from Anchorage

The crib for the first river pier of the Buffalo-Fort Erie bridge over the Niagara River, on Sept. 10, while being secured alongside a scow anchored at the pier site broke loose from its moorings and floated a considerable distance down the river before it was got under control and brought back to shore. Another attempt to float the crib into place will be made this week.

Sir Henry Thornton to Continue as Head of Canadian National

Henry W. Thornton, now Sir Henry Thornton, chairman and president of the Canadian National Rys., the government owned railways of Canada, has been re-engaged by the Canadian Government for a period of three years at a salary stated to be $65,000, thus placing him on a par in regard to salary with the president of the Canadian Pacific Ry. Sir Henry is a native of Logansport, Ind., and a graduate of the University of Pennsylvania in the department of civil engineering. In 1914, while serving as general superintendent of the Long Island R.R., he was called to England as general manager of the Great Eastern Ry. In 1922 was appointed president of the Canadian National Rys.

Board Appointed to Investigate Shenandoah Disaster

A court of inquiry to investigate the Shenandoah disaster has been appointed by Secretary Wilbur to meet at Lakehurst, N. J., at a date to be fixed later. The personnel of the court is as follows: Rear Admiral Hilary P. Jones, Capt. Frank H. Clark, Capt. Lewis B. McBride of the Naval Construction Corps, Commander John T. Towers, Lieut. Commander Ralph C. Pennoyer.

Capt. Paul Foley, director of Experimental Laboratory, will serve as judge advocate and Lieut. Commander M. R. Pierce, adviser to judge advocate.

Commander Towers is a naval aviator and both Lieut. Commanders Pierce and Pennoyer are lighter-than-air pilots. The latter was inspector on the construction of the Los Angeles and is familiar with the details of the construction of the Shenandoah.

Another board, to inquire into the whole aviation policy of the government has been appointed by the President. This board consists of the following men:

Major Gen. James G. Harbord, retired, of New York City; Rear Admiral Frank F. Fletcher, retired, of Washington, D. C.; Dwight W. Morrow of Englewood, N. J., lawyer and banker; Howard E. Coffin of Detroit, consulting engineer and expert in aeronautics; Colonel Hiram Bingham of New Haven, Conn., Senator, formerly in the air service and member of the Senate Committee on Military Affairs; Hon. Carl Vinson of Milledgeville, Ga., member of the House Committee on Naval Affairs; James S. Parker of Salem, N. Y., Chairman of the House Committee on Interstate and Foreign Commerce; Hon. Arthur C. Denison of Grand Rapids, Mich., Judge of the Sixth Circuit Court of Appeals; William F. Durand of Los Angeles, Cal., President of the American Society of Mechanical Engineers, member of the National Advisory Committee for Aeronautics.

This board has been requested by the President to have its report ready by the latter part November.

No definite announcement has been made as to how the hearings are to be held but it is expected that most of them will be open sessions.

Conowingo Hearing Set for Oct. 5

Final argument before the Pennsylvania Public Service Commission in the application of the Susquehanna Power Co. for authority to build a large hydro-electric power plant on the Susquehanna River at Conowingo is to be heard on Oct. 5.

Straightening the Chicago River

That the project for straightening the Chicago River between Polk and 16th Sts. will benefit both the city and the railroad companies owning river-front property is the conclusion of a report to the mayor by a citizens' committee. Some property now on the west side will be on the east side, but general layout of property will be more favorable and the city will be able to construct two or three additional and much-needed through streets from the business district to the southern section. The estimated cost is $4,550,000 for cutting the new channel, filling the old channel, building bulkhead or dock walls and shifting the bascule bridge of the St. Charles Air Line R.R. In addition, the city will have to pay for new street bridges over the new channel. It is expected that the more logical arrangement of property will increase its value so that the railways will not suffer any loss due to the change. The project is now before the railway presidents for consideration.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Fall Meeting, Montreal, Que., Canada, Oct. 14-16, 1925.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Convention, St. Louis, Mo., Oct. 19-22, 1925.

AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION, Chicago, Ill.; Annual Convention, Buffalo, N. Y., Oct. 20-22, 1925.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Lakeland, Fla.; Annual Meeting, Des Moines, Iowa, Oct. 26-30, 1925.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, Detroit, Mich., Nov. 18-20, 1925.

The Western Society of Engineers opened its fall schedule Sept. 14 with a paper on "Structural Design of Bridges in Grant Park," by C. R. Hoyt, structural engineer, South Park Commission, Chicago. The seven viaducts of the continuous girder type over the Illinois Central tracks presented the unusual complications of long spans, shallow clearances and limited foundations. "Corrosion of Underground Structures," by A. J. Fecht, electrical engineer, with W. G. Woolfolk, Chicago, is the subject for Sept. 21. On Sept. 28 the meeting will be held in the assembly hall of the new Union Station and J. D'Esposito, chief engineer, will present the first of a series of three talks on the station. An excursion was made Sept. 18 to Waukegan to view the plants of the Johns-Manville Co. and the 50,000-kw. power plant of the Public Service Co. of Northern Illinois.

Personal Notes

H. DEB. PARSONS, consulting engineer, New York, will attend the 100th anniversary celebration of the foundation of the Karlsruhe Polytechnic, probably the oldest engineering school in Germany, which is to be held on Oct. 28-31. Mr. Parsons will represent the American Society of Civil Engineers and Rensselaer Polytechnic Institute. PROF. CHARLES D. MARX will represent the American Society of Mechanical Engineers.

W. O. HOTCHKISS, director of the Wisconsin Geological Survey and a member of the Wisconsin State Highway Commission, has been appointed president of the Michigan State School of Mines, at Houghton, Mich.

GEORGE E. TEBBETTS has been appointed designing engineer of the Chicago Elevated Rys. Mr. Tebbetts is a native of Chicago and a graduate of the University of Illinois, class of 1899. In 1902 he went to the bridge department of the Chicago, Milwaukee & St. Paul Ry. as a detailer and since then has devoted the greater part of his time to bridge design, having been in charge of the design and erection of structures for the Kansas City Terminal Ry. and in charge of bridge work for the Chicago, Burlington & Quincy Ry. including the Chicago track elevation work. During the war he was assistant manager of the Wooden Ship Division, Emergency Fleet Corporation, and more recently has been with the York River Shipbuilding Corporation.

WELLINGTON RUPP, electrical engineer with the Washington state department of public works since 1921, has been appointed chief engineer of the department, succeeding JAMES W. CAREY, who resigned from that position, effective Sept. 14, to engage in private engineering practice in Seattle. MILES E. CLARK, assistant engineer with the department since 1919, has been appointed assistant chief engineer effective Sept. 14.

MAJOR DE WITT CLINTON JONES, recently a student at the Army War College, has been appointed district engineer, Buffalo district, to succeed Paul S. Reinecke, recently appointed assistant chief engineer of the Federal Power Commission.

Obituary

CLEVELAND JUSTIS, Dover, Del., resident engineer of the State Highway Department of Delaware, was instantly killed at Saxon's R.R. Crossing just south of Wyoming, Del., on September 5, when the automobile in which he was riding was struck by a train. Mr. Justis had been connected with the highway department since 1919, coming from the duPont interests where he was employed both in an engineering and production capacity. His preliminary training was obtained in the Massachusetts State Highway Department. His recent duties were on the Willow Grove-Maryland road.

JOHN R. MCDONALD, head of the firm of J. R. McDonald & Sons Construction Co., died recently at Denver, Colo., age 65 years. Mr. McDonald was a native of Prince Edward Island, Canada, and has been in the construction business since he was 19 years of age.

W. S. KELLER, state highway engineer of Alabama, died at his home in Montgomery, Ala., Sept. 9, aged 51 years. Mr. Keller was appointed state highway engineer of Alabama in 1911 and had served continuously since that date, although during his illness of several months W. A. McCalla, principal assistant engineer, has acted for Mr. Keller at times. Mr. Keller was a civil engineering graduate of the University of Alabama and prior to becoming state engineer of Alabama had served as a county surveyor, as assistant engineer, for five years, of Shiloh National Park, and one year in the U. S. Bureau of Public Roads and a year as a county engineer in Alabama.

NATHANIEL A. THAYER, assistant engineer of the Transit Commission, New York City, died September 10, aged 44 years. Mr. Thayer was born in South Boston, Mass., and graduated in 1902 in civil engineering from Harvard University. Subsequent to graduation he served with various railways in the East and on dock and pier construction, and later as designing draftsman in connection with New York subways and elevated railways and city school buildings.

GEORGE T. FORSYTH, Portland, Ore., consulting engineer specializing in bridge design, died Aug. 30 in that city. Mr. Forsyth studied engineering at Stanford University from 1895 to 1899, then worked in the bridge engineering department of the Harriman lines and with the Union Bridge & Construction Co. and later was vice-president of the Western Foundation Co. at Toronto. Since 1919 he had followed private practice in bridge engineering at Portland.

DR. H. R. CARTER, assistant surgeon general of the United States and noted, many years ago, for his work in combating yellow fever, both as a sanitary engineering expert and from the medical standpoint, died Sept. 14 at his home in Washington, D. C. Dr. Carter graduated in civil engineering from the University of Virginia in 1873 and from the University of Maryland School of Medicine in 1879 and thereafter served for many years in the United States Public Health Service, progressing from assistant surgeon to surgeon and senior surgeon. From 1904 to 1909 he was director of hospitals in the Panama Canal Zone.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

New Size Building Mixer Is Approved

At a meeting of the Mixer Manufacturers Bureau of the Associated General Contractors in Chicago, Sept. 3, the 10-S building mixer was approved as a standard size. This machine had been on probation until its usefulness could be gaged.

Further business at the meeting consisted in the authorization of the bureau's technical committee to make a study of safety measures which can be employed in connection with the operation of concrete mixers.

Concrete Road Yardage

For August the square yardages included in concrete pavement contract awards according to the Portland Cement Association were: 6,368,201 for roads; 2,973,301 for streets; and 252,341 for alleys; or a total for the month of 9,593,843 sq.yd.

The accompanying table summarizes the statistics for the current year:

SQUARE YARDS OF CONCRETE PAVEMENT AWARDED DURING 1925

Month	Roads	Streets	Alleys	Total All Classes
Jan.	3,474,421	963,256	75,236	4,512,913
Feb.	3,787,192	1,201,224	58,723	5,047,139
March	5,728,862	2,483,662	190,553	8,403,077
April	12,462,646	4,431,220	469,117	17,362,983
May	7,724,075	4,169,707	392,656	12,286,438
June	5,980,857	3,904,733	335,981	10,221,571
July	6,361,686	5,147,203	535,156	12,044,045
Aug.	6,368,201	2,973,301	252,341	9,593,843
Total	51,887,940	25,274,306	2,309,763	79,472,009

Business Notes

J. B. W. GARDINER, INC., has opened offices at 50 Church St., New York, as engineering specialists in waterproofing and corrosion problems. The head of the corporation, J. B. W. Gardiner, was president of Gardiner and Lewis, Inc., engineers and manufacturers, specializing in protection against water and corrosion. The earlier company separated recently and a company known as the Lewis Asphalt Engineering Corp. was formed, with Mr. Lewis president, Mr. Gardiner forming his own company as noted above.

STOCKLAND ROAD MACHINERY CO., Minneapolis, Minn., announces the appointment of the Illinois Equipment Co., Bloomington, Ill., to handle its road machinery in central Illinois. The latter company maintains branch sales offices at Springfield, Decatur and Danville.

AMERICAN CABLE CO., New York City, has appointed the following new distributors: Marion Machine Foundry & Supply Co., Marion, Ind.; J. Shuman Hower, 106 Foster Building, Utica, N. Y.; Contractors Equipment Co., Albany, N. Y.; John C. Louis, 221 South Eutaw St., Baltimore, Md.

CISCO MACHINE TOOL CO., Cincinnati, Ohio, has recently acquired control of the Century cement bag cleaner formerly manufactured by the Willsea Works, Rochester, N. Y., and will market this equipment in the future.

MARION STEAM SHOVEL CO., Marion, Ohio, announces the opening of new offices in Portland, Ore., in charge of Z. A. Toye, of the H. J. Armstrong Co., Seattle.

T. L. SMITH CO. Milwaukee, Wis., announces the appointment of McDonald & Burgman as its Florida agent, with offices at Daytona, Jacksonville, and Miami.

GENERAL ELECTRIC CO., Schenectady, N. Y., announces the appointment of T. W. Frech, Cleveland, Ohio, and W. R. Burrows, Harrison, N. J., as associate managers of the incandescent lamp business of the company. They will relieve G. F. Morrison, F. S. Terry, and B. G. Tremaine. Mr. Morrison is vice-president and director of the company, Mr. Terry is a vice-president and Mr. Tremaine is a director. They will continue to be connected with the company in these capacities. G. C. Osborne has been appointed sales manager of the Edison lamp division, a position formerly held by A. D. Page. Mr. Page will continue as a member of the advisory lamp committee, which now consists of Gerard Swope, G. F. Morrison, F. S. Terry, B. G. Tremaine, and A. D. Page.

H. C. KOCH has been appointed vice-president of the International Cement Corp. He will have charge of sales and publicity for the domestic and foreign properties of the International system. Mr. Koch has been general sales manager of the International for several years, prior to which time he was in charge of the sales of the Texas Portland Cement Co. It is also announced that Ejnar Posselt will assume the duties of vice-president of the Virginia Portland Cement Corp. in charge of operation and construction as soon as the Norfolk plant is completed. Mr. Posselt has previously been vice-president in charge of foreign subsidiaries in the International system.

HYMAN-MICHAELS CO., Chicago, has purchased the physical assets and property of the Kalamazoo, Lake Shore & Chicago Ry., which was recently granted permission by the Interstate Commerce Commission to discontinue service and abandon its lines because of competing motor transportation. The road consists largely of No. 1-80 lb. ASCE section relaying rail. Dismantling work on the road has already begun, and the entire equipment will be sold.

MARINE METAL & SUPPLY CO., INC., New York City, recently purchased the Austin construction equipment in Toledo, Ohio, that has been heretofore offered for sale by a Philadelphia concern through the Industrial Plants Corp., New York. The latter company acted as agent for Marine Metal in the purchase of this equipment and has been appointed general agent for its sale.

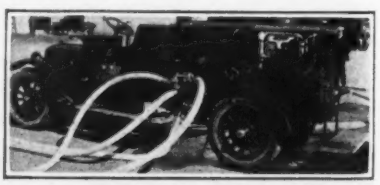
RAILWAY CAR MANUFACTURERS ASSOCIATION, an organization of corporate members, which has served the industry since 1915, has been superseded by the American Railway Car Institute, an organization of individuals interested in railway car manufacturing and repairing. The office of the Institute is at 61 Broadway, New York City. W. F. M. Goss, the president of the Railway Car Manufacturers' Association, states that the change has seemed to be in the interests of the industry. J. M. Hansen is president and W. C. Tabbert secretary of the newly formed American Railway Car Institute.

HEIL CO., Milwaukee, Wis., announces that the name of the Spinks Supply Co., Memphis, Tenn., Heil distributors, has been changed to Universal Equipment Co., Inc. The Watkins Commercial Body Co., Buffalo, N. Y., has been appointed as a new distributor of Heil products.

Equipment and Materials

Low-Cost Booster Pump for Fire Protection

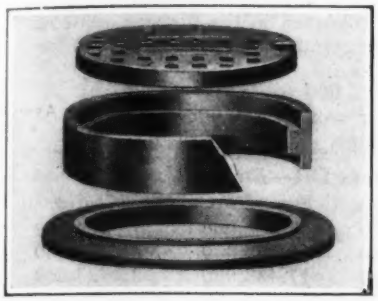
The usual motor pumper is a highly expensive piece of apparatus, due in part to the special chassis employed and in part to the use of a multi-stage centrifugal or rotary pump, as required to match ordinary automobile engine speeds. In order to make available a less expensive motor pumping unit, the De Laval Steam Turbine Co.



has recently developed a unit consisting of a 5-in. single-stage centrifugal pump with gasoline engine mounted upon a 1-ton truck chassis. The equipment is designed to deliver 600 g.p.m. against 100 lb. per square inch when driven at 1,750 r.p.m. A large overload capacity has made possible the pumping of 1,250 g.p.m. The equipment shown in the illustration is used by the Pueblo, Colo, fire department in outlying sections of the city. It utilizes two 1½-in. fire nozzles.

Reversible Manhole Cover of Sturdy Construction

A manhole cover whose curb may be removed and turned over after the top of the flange has been worn by the jars of traffic passing over the lid is a product of Shanley Reversible Manhole Cover, Chicago, who authorizes various foundries to manufacture

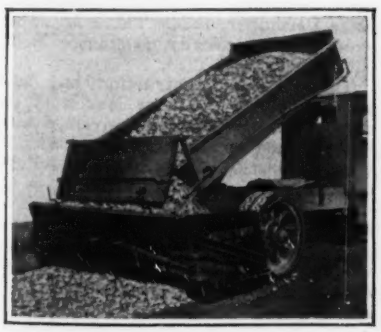


it. The Shanley cover has been adopted as standard for use on new and replacement work by the City of Chicago, where about 20,000 are now in use. The cover is made in three parts—base, curb and lid. The base is set in the pavement, the curb rests on the base and the lid rests on the curb. The flange in the curb is 3 in. deep giving a very rugged construction as evidenced in recent tests where a 1,200 lb. ball dropping on the cover from a height of 17 ft. failed to crack the casting. The weight of the cover is 440 lb.

Machine Distributes Road Building Materials Over Sub-Grade

A machine that distributes crushed rock or a hot asphaltic concrete mix over the sub-grade directly from motor trucks to any thickness up to 7 in. is manufactured by M. M. Butler & Co., Los Angeles, Cal., and is known as the Butler Distributor. It is essentially a roller-mounted hopper made of $\frac{3}{8}$ in. steel plates and angle iron bracing with an adjustable gate in the rear through which the material flows. The principle upon which the machine is built is to pull out from under the load rather than through it. The hopper is 8 ft. wide in front, 9 ft. in the rear and distributes the spread from 6 to 9 ft. by means of an adjustable shut-off device and side wings. Attachment is made to the rear of the motor truck by chains.

This machine was used on the construction of a 36-mile asphaltic concrete road in Kern County, California. The percentage of asphalt used varied from 7 to 15 and the maximum size of aggregate was $1\frac{1}{2}$ in. No trouble was experienced from balling-up of the mix. An 8-in. platform on the rear of the distributor enables the operators to keep off of the hot material. Attachments are available for laying shoulders, for operating on crown sheets and for other special conditions.



Seamless Metal Hose for Construction Use

A new metal hose or flexible pipe made by corrugating either seamless bronze or seamless steel tubing that is capable of withstanding pressures up to 10,000 lb. hydrostatic, temperatures as high as 1,000 deg. F., and constant bending as the service requires is a product of Chas. Cory & Son, Inc., New York. Any fitting of standard design and thread may be applied to this metal hose by either welding or brazing. The manufacturer's claim is that the hose will fill a need experienced by engineers, contractors and power plant

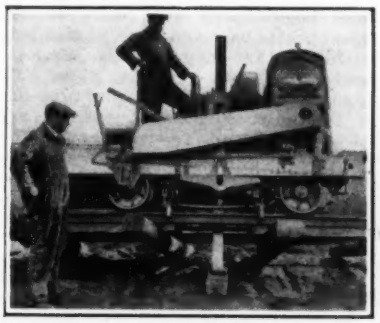
operators who must handle materials and pressures outside the range of ordinary hose. The life of this hose is claimed to be very long since it can be repaired by welding.

This hose finds application in such uses as for hot tar, asphalt, etc.; for expansion joints of different shapes in connection with highest steam pressures; for suction purposes up to 12 in. I.D.; for high-pressure fuel oil burners; for any vacuum service; and for gasoline, alcohol and other substances.

Self-Propelling Machine Shifts and Raises Track

A machine especially useful for waste dumps, steel plants, quarries and all construction work which necessitates frequent moving of the track, is manufactured by the Nordberg Mfg. Co., Milwaukee, Wis. The equipment is a railway motor car with sufficient platform room for tools and men in addition to the necessary operating equipment for track shifting. The track to be shifted is clamped to the car as shown in the illustration. The spud is then racked down at the proper angle or tilt which is determined by the distance that the track is to be moved. The foot piece rests between the ties. The force exerted on the rack by meshing with a cog wheel raises the machine and track. With the spud offset from the center of the track, the rails and ties on that side will be raised first and as the height increases and more track is lifted from the ground, the load becomes so heavy on the tilted spud that it falls over and carries the entire track section to a new position. By placing the spud midway between the rails, the machine lifts the track perpendicular providing a rapid means of raising low spots and of facilitating general surfacing work.

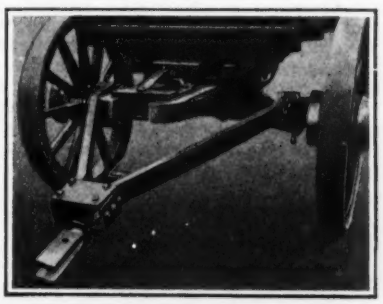
The power unit is a 40 hp. motor.

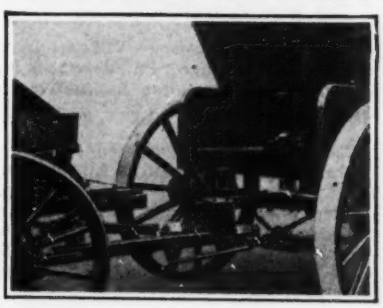


The downward speed of the spud when lifting is about $22\frac{1}{2}$ ft. per min. The worm and gear as well as the transmission run in baths of oil and are completely enclosed. The machine has a speed of 25 m.p.h.

Direct Pull from Tractor to Each Wagon Through New Draw Bar

The new all-steel spring draw bar for contractor's dump wagons manufactured by the Watson Truck Corp., Canastota, N. Y., permits a direct pull from the tractor to all wagons in the train. The equipment is sold in two units, a "tractor-to-wagon" and a "wagon-to-wagon" hitch shown in the upper and lower illustrations respectively. The attachments fit any Watson wagon and special adapters are furnished for different types of trucks or tractors. The coupling pole attaches directly over the axle near the outside instead of being inserted in the hounds of the wagon. This latter method of coupling is claimed to pry the body box from the lower gears when the wagon





is inclined at a steep pitch. The wagons can be made ready for teams by removing 2 bolts and inserting pole equipment.

New Switchboard Made of Steel

Steel switchboards have been used on small installations in a more or less experimental way and have proved successful, so that they are now being installed on larger projects. The outstanding features of this new type are its lightness, substantial nature, appearance and inexpensiveness. The erection and maintenance costs are lower than those of slate and marble boards. The erection, in addition to being cheaper, is more simple since the framework is an integral part of the panels. The steel panels are given a baked enamel finish. These steel switchboards are said to be impervious to moisture and to resist the corroding action of salt sea air. They are a new product of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Publications from the Construction Industry

Electric Cranes & Hoists—SHEPARD ELECTRIC CRANE & HOIST CO., Montour Falls, N. Y., has published bulletin No. 80, a 38-p. booklet, describing all of the equipment made by this company for the iron and steel industry. A general description of each machine is given along with a photo and an actual installation view. The catalog is indexed in three ways: As to applications, material handled, and Shepard equipment.

Damp-Proofing—STRUCTURAL WATERPROOFING CO., New York, has prepared a booklet to illustrate the damp-proofing treatment of two methods of construction, namely, hollow back-up tile, and skeleton construction. The bulletin describes a semi-mastic substance that may be daubed on rough surfaces with the usual brush. Descriptions and specifications of the "Spandrel-Tite" method, which consists of a waterproof membrane of tarred felt and asphalt asbestos mastic applied cold over the top and side of all exposed spandrel beams, is also given.

Electric Motors—CENTURY ELECTRIC CO., St. Louis, Mo., has issued a 15 p. catalog describing its squirrel cage induction polyphase motors. Descriptions are given of all the important details of this type of motor.

Gasoline Locomotives—VULCAN IRON WORKS, Wilkes Barre, Pa., describes its 16 and 20 ton gasoline locomotive in a new bulletin.

Road Building Equipment—C. D. EDWARDS MFG. CO., INC., Albert Lea, Minn., has made available a new 25 p. catalog describing such road building equipment as graders, rotary snow plows, fresno scrapers, slip scrapers, road drags, wheel scrapers, plows, and levelers.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks.

Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

Money Value of Contracts Let—Entire U. S.

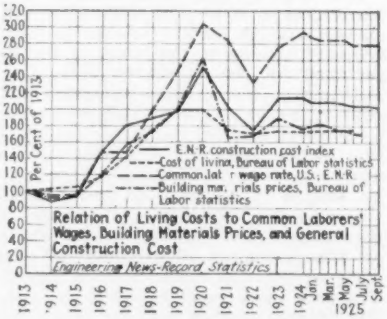
Week Ending	Public Work	Private Work	Total Contracts
September 17, 1925	$28,860,000	$45,006,000	$73,866,000
September 10, 1925	17,898,000	28,553,000	46,451,000
September 18, 1924	18,270,000	17,463,000	35,733,000
Heaviest Week			
1925, Sept. 3	16,215,000	69,424,000	85,639,000
1924, May 8	26,370,000	38,829,000	65,199,000
January 1 to Date			
1925	778,170,000	1,033,608,000	1,811,778,000
1924	746,151,000	754,568,000	1,500,719,000

Living Costs Rise—Volume of Construction Greater

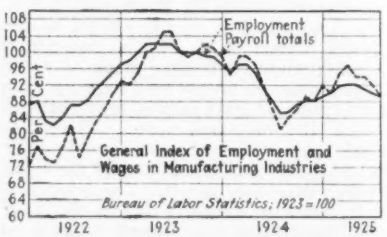
Recession In Employment and Factory Pay-Rolls—Building Costs Lower with Exception of Lumber and Labor

LIVING costs continue to increase despite the fact that employment in the manufacturing industries of the country, as well as pay-roll totals in the various establishments, is tending downward. Both in employment of labor and in money paid out as wages, this year is ahead of 1924 to date. A slower pace, however, is indicated when this year is compared with the high production period of 1923.

According to latest reports of the Bureau of Labor Statistics, the cost of living in June, 1925, was 73.5 per cent above the 1913 level as against 72.5 per cent above in December, 1924.


Per Cent of 1913
E.N.R. construction cost index
Cost of living, Bureau of Labor statistics
Common labor wage rate, U.S., E.N.R.
Building materials prices, Bureau of Labor statistics
Relation of Living Costs to Common Laborers' Wages, Building Materials Prices, and General Construction Cost
Engineering News-Record Statistics
1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 Jan Mar May July Sept 1925

The National Industrial Conference Board computes the cost of living for July, 1925, as 68.7 per cent above the 1914 level as compared with 66.9 per cent above, in June, 1925. This authority reports a rising tendency in food, clothing, fuel and light and a decline in cost of shelter. According to the Bureau of Labor Statistics there was a drop of 1.4 per cent in the price of electricity between December, 1924, and June, 1925. The Conference Board places the purchasing value of the dollar at 59.3 cents as contrasted with one dollar in July, 1914.

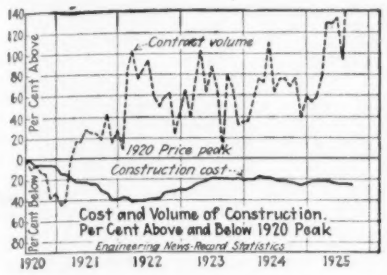

Per Cent
Employment
Payroll totals
General Index of Employment and Wages in Manufacturing Industries
Bureau of Labor Statistics; 1923 = 100
1922 1923 1924 1925

Although the general trend of all wages is obviously upward, owing to constant introduction of improved machinery, the national rate for common laborers, in construction operations has been stepping gradually downward since December, 1924. There has, however, been practically no change in the rate since June, 1925.

The cost of construction has been tending downward since March of the current year. This has given rise to the increase in actual physical volume of construction that usually follows lower costs.

From the accompanying charts it is seen that the upward trend in the cost of living is coexistent with an increasing volume of construction. At the same time there is a downward inclination in cost of construction, due mostly to

declines in prices of certain materials. There is also lessened employment of factory labor and smaller pay rolls.



In money value of contracts let, this year (Jan. 1 to date) is 20 per cent ahead of last.

The actual physical volume of August construction (not the mere money value of contracts let) is the heaviest for any month on record.

From "Proposed" to "Contract Awarded" Averages Three Months

EIGHTY-EIGHT per cent of all projects reported in any month as definitely proposed are under contract within three months, according to an analysis of 1924 Construction News figures. Occasionally projects are awarded many months—even several years—after their first consideration, but six months sees 97 per cent of such work under contract.

The tabulation gives the percentages of the projects contemplated in any month that are awarded in that and the other months. For example, of 375 jobs reported proposed in January, (1924) 29 per cent was placed under contract in that same month, 40 per cent in February, 14 per cent in March, 4 per cent in both April and May, and 3 per cent in June.

The foregoing figures refer to number of projects; the same situation is true with respect to value. Following are the percentages of the total monthly values of 1924 construction projects that went through to contract in the first three months after they were reported as proposed: January, 86 per cent; February, 82; March, 92; April, 91; May, 91; June, 88.

MONTH IN WHICH PROJECT DEVELOPED

Contract Awarded	Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
	Same	29	19	23	23	39	29	30	23	24	43	25	22	27 4
	Second	40	48	48	57	43	50	42	51	53	33	45	22	44 3
	Third	14	14	19	12	10	13	19	16	14	12	16	39	16 5
	Fourth	4	8	4	3	3	4	5	5	5	6	7	8	5.1
	Fifth	4	4	2	3	1	1	1	2	1	2	3	6	2.5
	Sixth	3	1	2	1	1	1	1	1	1	1	1	2	1.3

Slowness in Bond Sales for State and Municipal Improvement

STATE and municipal bond sales for August fell below those made during the month of July, according to the *Commercial and Financial Chronicle*. The disposals in August totaled $72,452,204 compared with $142,828,240 in July and with $108,220,267 in August a year ago. While there was a drop in bond sales during the past month, the above total for the month of August has been surpassed only twice, August 1921 and 1924, in the records for this month.

There were few large offerings for the month. The two largest placings were made by Baltimore, Md., $8,978,500 5s for general improvement and water supply and the $6,000,000 4s by the Chicago Sanitary District.

Among the other issues are the following: $3,800,000 5s Dade County Special Tax School District No. 2, Florida; $2,000,000 4½s, water works, Los Angeles; $1,793,000 4½s, improvement, Miami, Fla.; $1,349,500 4½s, paving, New Orleans, La.

The rates in the following table range from 4¼ to 6 per cent. Most of the disposals commanded a premium but there were a few at par and below.

Representative Public Bond Sales, August, 1925

State	Purpose	Amount	Rate per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Arkansas	Building	$650,000	4½	100.58	....	Sept. 1	1930-45	Mississippi Valley Trust Co. and others
Delaware	Improvements	235,000	4½	100.63	4.21	Apr. 1	1926-72	Redmond & Co. and others
		486,613	4	97.322	4.14	Jan. 1	1965	A. M. Lamport & Co., Inc.
Montana	Educational	592,000	4½	100.63	4.43	Aug. 14	20 yrs.	The Wells-Dickey Co. and others
North Dakota	Real estate	1,000,000	4½	.....	4.32	April 1	1950-54	Board of University and School Lands
County								
Adams, Ind	Roads	42,640	4½	101.11	4.27	Aug. 15	1926-35	Fletcher American Co.
Allen, Ind	Highway	508,000	4½	.....	....	Aug. 15	1926-45	Citizens' Trust Co.
Alameda, Calif	Tube	500,000	5	101.47	4.23	.....	1926-28	Mercantile Securities Co.
Albany, N. Y	Highway	180,000	4½	101.89	4.07	Aug. 1	1926-55	Fairservis & Co.
Blount, Tenn	Highway	35,000	5	100.38	4.89	Sept. 1	1926-32	A. T. Belt & Co.
Butte, Ida	Road and bridge	40,000	4½	.....	....	Aug. 1	1935-44	Swaner, Chamberlain & Co.
Coconino, Ariz	Courthouse	50,000	5	103	4.79	July 15	1950	Geo. W. Vallery & Co.
De Kalb, Ind	Highway	11,000	4½	101.80	....	July 15	.....	Breed, Elliott & Harrison
Decatur, Ind	Road improvement	40,000	4½	103.14	4.13	Aug. 15	1926-45	Union Trust Co.
El Paso, Tex	Court house and jail	204,000	4½	.....	....	Apr. 10	1934-60	The Harris Trust & Savings Bank of Chicago
Galveston, Tex	Roads	500,000	5	101.41	....	Aug. 1	1-30 yrs.	Blanton Banking Co. of Houston
Hancock, Ia	Drainage	12,000	5	100.79	....	.....	4-10 yrs.	Geo. M. Bechtel & Co.
Henry, O	Road improvement	82,000	5	102.03	4.56	Aug. 1	1926-34	Herrick Co. of Cleveland
Jefferson, O	Road improvement	13,216	5	101.02	....	Oct. 1	1926-33	Breed, Elliott & Harrison
Lake, Fla	Road and Bridge	750,000	6	103.16	5.74	July 1	1935-55	Marx & Co. and others
		985,000	6	97.11	6.26	July 1	1935-55	
		900,000	6	100.75	5.94	July 1	1935-55	Atlantic National Bank of Jacksonville and others
		650,000	6	100.10	5.99	July 1	1935-55	
		150,000	6	101.02	5.37	July 1	1935-55	
Lucas, O	Bridge	112,847	4½	100.369	4.43	Aug. 1	1926-35	Provident Savings Bank & Trust Co. of Cincinnati
Lenawee, Mich	Road	114,000	4½	100.09	....	Aug. 21	1 to 15 yrs.	Stranahan, Harris & Oatis, Inc.
Manatee, Fla	Highway and bridge	100,000	5	.....	....	April 1	1940-55	The Florida National Bank
Nassau, N. Y	Improvements	244,000	4½	102.147	4.08	July 1	1935-46	Pulleyn & Co. and others
Township								
Little Falls, N. J	Sewer	38,000	4½	100.31	4.475	July 1	1927-64	Little Falls National Bank
Penn, Pa	Improvements	38,000	4½	102.41	4.19	Aug. 1	1926-44	Mellon National Bank
Pontiac, Ill	Road	30,000	5	.....	....	Aug. 1	1927-29	The Illinois State Savings Bank
Municipal								
Akron, O	Street improvement	502,600	5	102.679	4.46	Aug. 1	1926-35	Eldredge & Co. of N. Y.
Ann Arbor, Mich	Paving	77,000	4½	100.67	4.39	Aug. 1	1929-35	Harris Trust & Savings Bank of Chicago
Abilene, Tex	Water purification	250,000	..	100.30	....	.....	.....	Brown-Crummer of Wichita
	School building	160,000						
	City Hall	125,000						
	Auditorium	75,000						
	Sewer	50,000						
	Station	50,000						
Atlanta, Ga	Streets	90,000	4½	100.56	4.38	Aug. 1	1927-34	Hibernia Securities Co.
Batavia, N. Y	Street improvement	151,470	4.30	100.03	4.29	May 1	1926-35	Pulleyn & Co. and others
	Fire apparatus	26,000						
Butler, Pa	Street	70,000	4½	102.60	4.08	July 1	1945-51	Union Trust Co.
Boston, Mass	Hospital	43,000	4	100	4	July 1	1926-45	Trust Funds
	Laboratory	25,000						
	Playground impv'mt	15,000						
Baker, Ore	Improvements	38,500	6	.....	....	Mar. 1	1926-35	Ralph Schneelock Co.
Bridgeton, N. C	Street improvement	15,000	6	100	6	June 1	1928-42	Ryan, Sutherland & Co.
Canton, O	Storm sewer	6,728	5	102.24	4.54	Mar. 1	1927-35	A. E. Aub & Co.
	Improvements	15,443						
Fort Myers, Fla	Street improvement	70,000	6	102.89	5.30	Dec. 1	1925-34	Atlantic National Bank

Weekly Construction Market

WITH construction, Jan 1, to Sept. 17, 1925, 20 per cent ahead of the corresponding period last year, nothing short of a calamity can prevent 1925 from becoming the record year.

After that comes the question of 1926—will the building boom continue or will over-expansion cause a reaction in the construction industry?

If we *are* on a new plane of construction demand, where the present practice of investing huge sums of money in individual building projects can continue indefinitely, then over-expansion is out of the question.

If not, the greatest danger of over-building from the beginning of 1926 on out, will lie in the direction of high-priced dwellings, commercial and public buildings and not public works and utilities or low-priced housing facilities.

The following tabulation shows the gain or loss, in percentages, of all classes of construction except residential, for the entire country, Jan. 1 to Sept. 1, 1925, compared with the corresponding period last year:

Gain Over 1924		Loss Compared With 192	
Class	Per cent	Class	Per cent
Miscellaneous	34	Excavation	44
Commercial buildings	31	Bridges	16
Sewers	15	Federal Government	11
Streets and roads	0.9	Industrial buildings	5
		Water-works	4

The miscellaneous or unclassified jobs, that showed greatest gains over this period, last year, consist of such projects as bulkheads, grain elevators, jetties, piers, pipe lines, subways, sea walls, stadiums, wharfs, etc.

With sustained demand for building materials exerting a steady pressure upon the mills, it is worth noting that the general price tendency for the past six months or more, has not been upward. The chief danger of increased cost of construction lies, therefore, in the direction of higher building trades' wage schedules.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.90	$4.00	$3.10	$3.35	$3.07½	$3.30	$3.35	$4.25
Structural rivets, 100 lb	4.50	4.45	4.75	3.50	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb	3.24	3.40	2.80	3.00	3.25	3.62½	3.35	3.25	2.30
Steel pipe, black, 3½ to 6 in. lap, discount	48%	58%	53.6%	51%	54.25%	36%	39.2@51%	50%	59.49
Cast-iron pipe, 6 in. and over, ton	50.60@51.60	+46.00	54.00	49.20@50.20	53.00	63.00	52.00	53.00	55.00
Concreting Material									
Cement without bags, bbl	2.50@2.60	2.25	2.05	2.20	2.42	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd	1.75	2.20	2.38	2.00@2.20	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd	1.00	1.65	2.00	+2.00@2.20	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.20	2.83	2.00@2.20	1.75	2.50	2.15	3.00	1.90
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	59.00	34.00	58.50	45.00	38.75	33.75	27.00	24.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	18.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.25@2.75	1.30	1.85	1.45	1.35	2.70	1.60	2.80	9.50
Common brick, delivered, 1,000	18.00	10.50	11.60	12.00	13.50	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0893	.10	.075	.....	.085	.....	.10	.12
Hollow partition tile 4x12x12, per block	.1162	.0893	.10	.075	.07	.085	.108	.10	.10
Linseed oil, raw, 5 bbl. lots, gal	1.08	—1.14	1.13	1.02	+1.14	+1.27	1.15	1.12	1.25
Common Labor									
Common labor, union, hour	.55@.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	.50@.55	.35@.50	.50	.50	.25@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 55c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of September 3, the next on October 1.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Business Briefs

Call money quoted at 4½ per cent, Sept. 14; year ago, 2 per cent.

Time loans: short terms, 4½ per cent; longer periods, 4½ per cent.

Commercial paper: 4½ per cent for all names.

On September 1, 1925

E. N.-R. Construction Cost Index Number 202.10

E. N.-R. Construction Volume Index Number 266

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month